Drum
Digital Servo Drive
Installation Guide

April 2008 (Ver. 1.0)

Elmo
Motion Control

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Document No. MAN-DRUIG

Drum Catalog Number:	**DRU- A XX/YYY R** **Version**: Blank = Standard A = Advanced Continuous Current (Amps) Maximum DC Operating Voltage **Feedback:** Blank = Incremental Encoder and/or Halls R = Resolver I = Interpolated Analog Encoder T = Tachometer & Potentiometer Q = Absolute Encoder

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Contents

Chapter 1: Safety Information

In order to achieve the optimum, safe operation of the Drum servo drives, it is imperative that you implement the safety procedures included in this installation guide. This information is provided to protect you and to keep your work area safe when operating the Drum as well as the accompanying equipment.

Please read this chapter carefully before you begin the installation process.

Before you start, ensure that all system components are connected to earth ground. Electrical safety is provided through a low-resistance earth connection.

Only qualified personnel may install, adjust, maintain and repair the servo drive. A “qualified person” has the knowledge and authorization to perform tasks such as transporting, assembling, installing, commissioning and operating motors.

The Drum servo drives contain electrostatic-sensitive components that can be damaged if handled incorrectly. To prevent any electrostatic damage, avoid contact with highly insulating materials, such as plastic film and synthetic fabrics. Place the product on a conductive surface and ground yourself in order to discharge any possible static electricity build-up.

To avoid any potential hazards that may cause severe personal injury or damage to the product during operation, keep all covers and cabinet doors shut.

The following safety symbols are used in this manual:

	**Warning:** This information is needed to avoid a safety hazard, which might cause bodily injury.
	**Caution:** This information is necessary for preventing damage to the product or to other equipment.
	**Note:** This is auxiliary information that ensures the correct operation of the equipment.

1.1 Warnings

	To avoid electric arcing and hazards to personnel and electrical contacts, never connect / disconnect the servo drive while the power source is on.
	Power cables can carry a high voltage, even when the motor is not in motion. Disconnect the Drum from all voltage sources before it is opened for servicing.
	The Drum servo drives contain grounding conduits for electric current protection. Any disruption to these conduits may cause the instrument to become hot (live) and dangerous.
	After shutting off the power and removing the power source from your equipment, wait at least 1 minute before touching or disconnecting parts of the equipment that are normally loaded with electrical charges (such as capacitors or contacts). Measuring the electrical contact points with a meter, before touching the equipment, is recommended.

1.2 Cautions

	The Drum servo drives contain hot surfaces and electrically-charged components during operation.
	The maximum DC power supply connected to the instrument must comply with the parameters outlined in this guide.
	When connecting the Drum to an approved 12~195 VDC auxiliary power supply, connect it through a line that is separated from hazardous live voltages using reinforced or double insulation in accordance with approved safety standards.
	Before switching on the Drum, verify that all safety precautions have been observed and that the installation procedures in this manual have been followed.

1.3 Directives and Standards

The Drum conforms to the following industry safety standards:

Safety Standard	**Item**
In compliance with **ISO-9001:2000**	Quality Management
In compliance with **UL508c**	Power Conversion Equipment
In compliance with **UL840**	Insulation Coordination, Including Clearance and Creepage Distances of Electrical Equipment
In compliance with **UL60950-1** (formerly UL1950)	Safety of Information Technology Equipment, Including Electrical Business Equipment
In compliance with **EN60204-1**	Low Voltage Directive, 73/23/EEC

The Drum servo drives have been developed, produced, tested and documented in accordance with the relevant standards. Elmo Motion Control is not responsible for any deviation from the configuration and installation described in this documentation. Furthermore, Elmo is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.

1.4 CE Mark Conformance

The Drum servo drives are intended for incorporation in a machine or end product. The actual end product must comply with all safety aspects of the relevant requirements of the European Safety of Machinery Directive 98/37/EC as amended, and with those of the most recent versions of standards EN60204-1 and EN292-2 at the least.

According to Annex III of Article 13 of Council Directive 93/68/EEC, amending Council Directive 73/23/EEC concerning electrical equipment designed for use within certain voltage limits, the Drum meet the provisions outlined in Council Directive 73/23/EEC. The party responsible for ensuring that the equipment meets the limits required by EMC regulations is the manufacturer of the end product.

1.5 Warranty Information

The products covered in this manual are warranted to be free of defects in material and workmanship and conform to the specifications stated either within this document or in the product catalog description. All Elmo drives are warranted for a period of 12 months from the time of installation, or 18 months from time of shipment, whichever comes first. No other warranties, expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.

Chapter 2: Introduction

This installation guide describes the Drum servo drives and the steps for its wiring, installation and power-up. Following these guidelines ensures maximum functionality of the drive and the system to which it is connected.

2.1 Drive Description

The Drum series are highly resilient digital servo drives designed to deliver "the highest density of power and intelligence". The Drum delivers up to **9.6 kW of continuous power** or **11.2 kW of peak power** in a compact package.

The digital drives are based on Elmo's advanced ***SimplIQ*** motion control technology. They operate from a DC power source in current, velocity, position and advanced position modes, in conjunction with a permanent-magnet synchronous brushless motor, DC brush motor, linear motor or voice coil. They are designed for use with any type of sinusoidal and trapezoidal commutation, with vector control. The Drum can operate as a stand-alone device or as part of a multi-axis system in a distributed configuration on a real-time network.

The drives are easily set up and tuned using Elmo's *Composer* software tools. This Windows-based application enables users to quickly and simply configure the servo drive for optimal use with their motor. The Drum, as part of the *SimplIQ* product line, are fully programmable with Elmo *Metronome* motion control language.

Power to the drives is provided by a 12 ~ 195 VDC isolated DC power source (not included with the Drum). The power stage is fully isolated from the control stage. A "smart" control-supply algorithm enables the Drum to operate with only one power supply with no need for an auxiliary power supply for the logic.

If back-up functionality is required for storing control parameters in case of power-loss, an external 12 ~ 195 VDC isolated supply should be connected (via the CAN connector on the Drum) providing maximum flexibility and backup functionality when needed.

Note: This back-up functionality can operate from any voltage source within the 12 ~ 195 VDC range. This is much more flexible than to be restricted by only using a standard 24 VDC power supply.

If back-up power is not needed, then the main power supply will also power the control / logic supply. In this way there is no need for a separate control / logic supply.

2.2 Product Features

2.2.1 Current Control

- Fully digital
- Sinusoidal commutation with vector control or trapezoidal commutation with encoder and / or digital Hall sensors
- 12-bit current loop resolution

- Automatic gain scheduling, to compensate for variations in the DC bus power supply

2.2.2 Velocity Control

- Fully digital
- Programmable PI and FFW (feed forward) control filters
- Sample rate two times current loop sample time
- "On-the-fly" gain scheduling
- Automatic, manual and advanced manual tuning and determination of optimal gain and phase margins

2.2.3 Position Control

- Programmable PIP control filter
- Programmable notch and low-pass filters
- Position follower mode for monitoring the motion of the slave axis relative to a master axis, via an auxiliary encoder input
- Pulse-and-direction inputs
- Sample time: four times that of current loop
- Fast event capturing inputs
- PT and PVT motion modes
- Position-based and time-based ECAM mode that supports a non-linear follower mode, in which the motor tracks the master motion using an ECAM table stored in flash memory
- Dual (position / velocity) loop
- Fast output compare (OC)

2.2.4 Communication Options

Drum users can use two communication options:

- RS-232 serial communication
- CANopen for fast communication in a multi-axis distributed environment

2.2.5 Feedback Options

- Incremental Encoder – up to 20 Mega-Counts (5 Mega-Pulse) per second
- Digital Halls – up to 2 kHz
- Incremental Encoder with Digital Halls for commutation – up to 20 Mega-Counts per second for encoder
- Interpolated Analog Sine / Cosine Encoder – up to 250 kHz (analog signal)
  Internal Interpolation - up to x4096
  Automatic Correction of amplitude mismatch, phase mismatch, signals offset
  Auxiliary emulated, unbuffered, single-ended, encoder output
- Resolver
  Programmable 10~15 bit resolution
  Up to 512 revolutions per second (RPS)
  Auxiliary emulated, unbuffered, single-ended, encoder output
- Tachometer, Potentiometer

- Absolute Encoder
    - Heidenhain 2.1
    - Stegmann
- Elmo drives provide supply voltage for all the feedback options

2.2.6 Fault Protection

The Drum includes built-in protection against possible fault conditions, including:

- Software error handling
- Status reporting for a large number of possible fault conditions
- Protection against conditions such as excessive temperature, under/over voltage, loss of commutation signal, short circuits between the motor power outputs and between each output and power input/return
- Recovery from loss of commutation signals and from communication errors

2.3 System Architecture

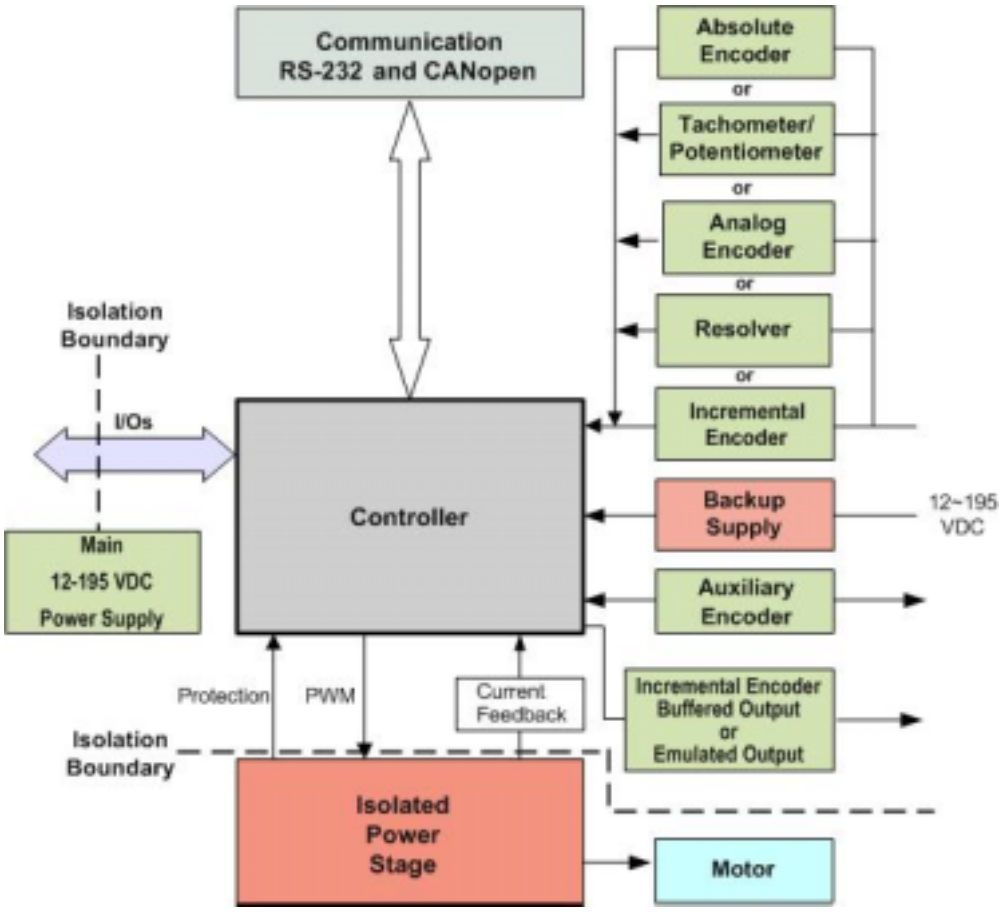


Figure 2-1: ***Drum System Block Diagram***

2.4 How to Use this Guide

In order to install and operate your Elmo Drum servo drives, you will use this manual in conjunction with a set of Elmo documentation. Installation is your first step; after carefully reading the safety instructions in the first chapter, the following chapters provide you with installation instructions as follows:

Chapter 3, *Installation*, provides step-by-step instructions for unpacking, mounting, connecting and powering up the Drum.

The Appendix, *Technical Specifications*, lists all the drive ratings and specifications.

Upon completing the instructions in this guide, your Drum servo drives should be successfully mounted and installed. From this stage, you need to consult higher-level Elmo documentation in order to set up and fine-tune the system for optimal operation. The following figure describes the accompanying documentation that you will require.

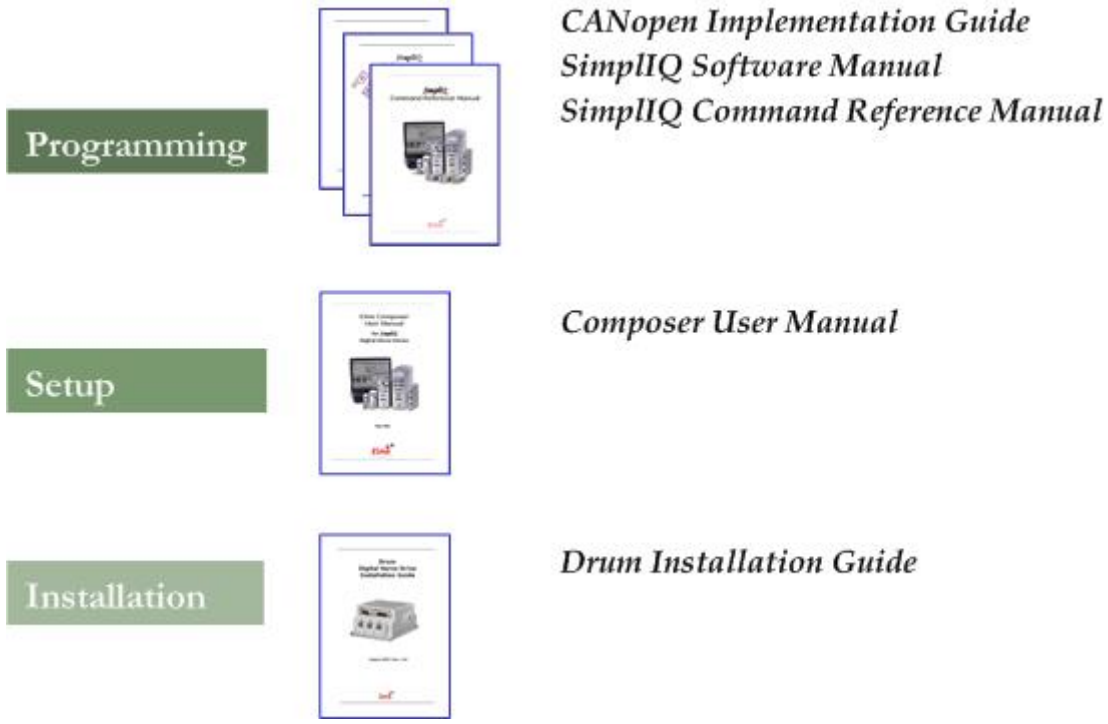


Figure 2-2: ***Elmo Digital Servo Drive Documentation Hierarchy***

As depicted in the previous figure, this installation guide is an integral part of the Drum documentation set, comprising:

- The *SimplIQ Software Manual*, which describes the comprehensive software used with the Drum.
- The *SimplIQ Command Reference Manual*, which describes, in detail, each software command used to manipulate the Drum motion controller.
- The Composer *Software Manual*, which includes explanations of all the software tools that are part of Elmo's Composer software environment.

Chapter 3: Installation

3.1 Before You Begin

3.1.1 Site Requirements

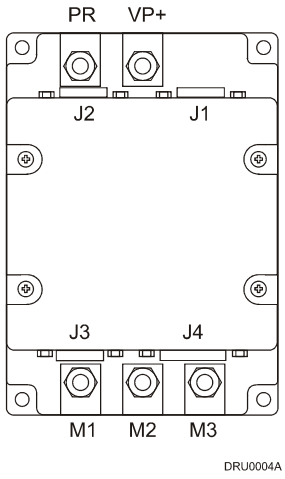
You can guarantee the safe operation of the Drum by ensuring that it is installed in an appropriate environment.

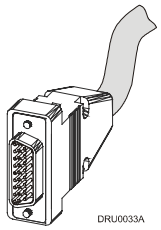
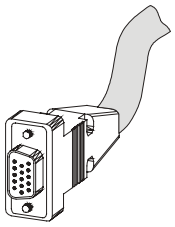
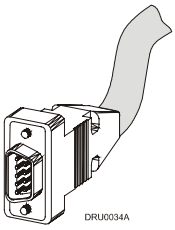
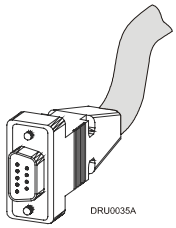
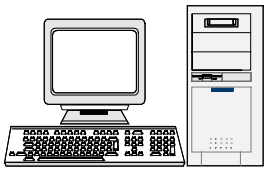
Feature	Value
Ambient operating temperature	0 °C to 40 °C (32 °F to 104 °F)
Maximum relative humidity	90% non-condensing
Operating area atmosphere	No flammable gases or vapors permitted in area
Models for extended environmental conditions are available.	

The Drum dissipates its heat by convection. The maximum operating ambient temperature of 0 °C to 40 °C (32 °F to 104 °F) must not be exceeded.

3.1.2 Hardware Requirements

The components that you will need to install the Drum are:

Component	Connector	Described in Section	Diagram
Main Power Cable	**VP+ PR**	3.4.2.2	
Motor Cable	**M1 M2 M3**	3.4.2.1	

Component	Connector	Described in Section	Diagram
Main and Auxiliary Feedbacks Cable	**FEEDBACK A and FEEDBACK B**	3.4.4	
Digital I/O and Analog Input Cable (if needed)	**GENERAL I/O J1**	3.4.7.1	
RS232 Communication Cable	**RS232**	3.4.8.1	
CANopen Communication cable(s) (if needed)	**CAN (in), CAN (out) and Backup Option**	3.4.8.2	
PC for drive setup and tuning			
Motor data sheet or manual			

3.2 Unpacking the Drive Components

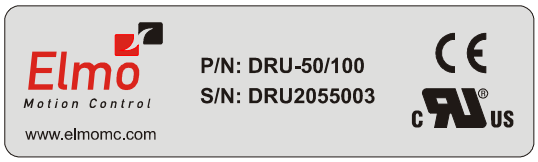
Before you begin working with the Drum system, verify that you have all of its components, as follows:

- The Drum servo drive
- The Composer software and software manual

The Drum is shipped in a cardboard box with styrofoam protection.

To unpack the Drum:

1. Carefully remove the servo drive from the box and the Styrofoam.
2. Check the drive to ensure that there is no visible damage to the instrument. If any damage has occurred, report it immediately to the carrier that delivered your drive.
3. To ensure that the Drum you have unpacked is the appropriate type for your requirements, locate the part number sticker on the side of the Drum. It looks like this:



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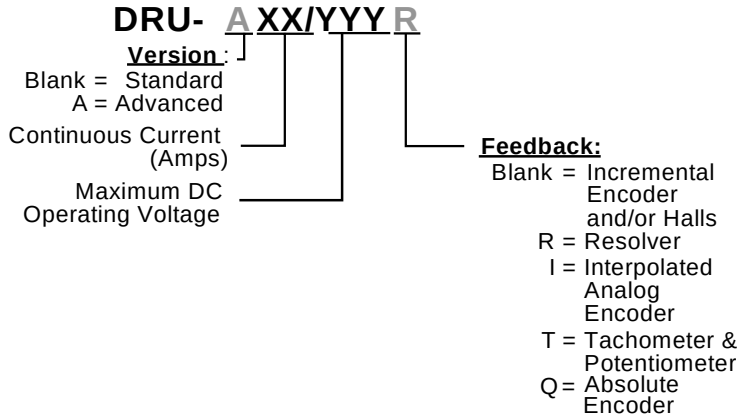
The P/N number at the top gives the type designation as follows:



4. Verify that the Drum type is the one that you ordered, and ensure that the voltage meets your specific requirements.

3.3 Mounting the Drum

The Drum has been designed for two standard mounting options:

- "Wall Mount" along the back (can also be mounted horizontally on a metal surface)
- "Book Shelf" along the side

M5 round head screws, one through each opening in the heat sink, are used to mount the Drum (see the diagram below).

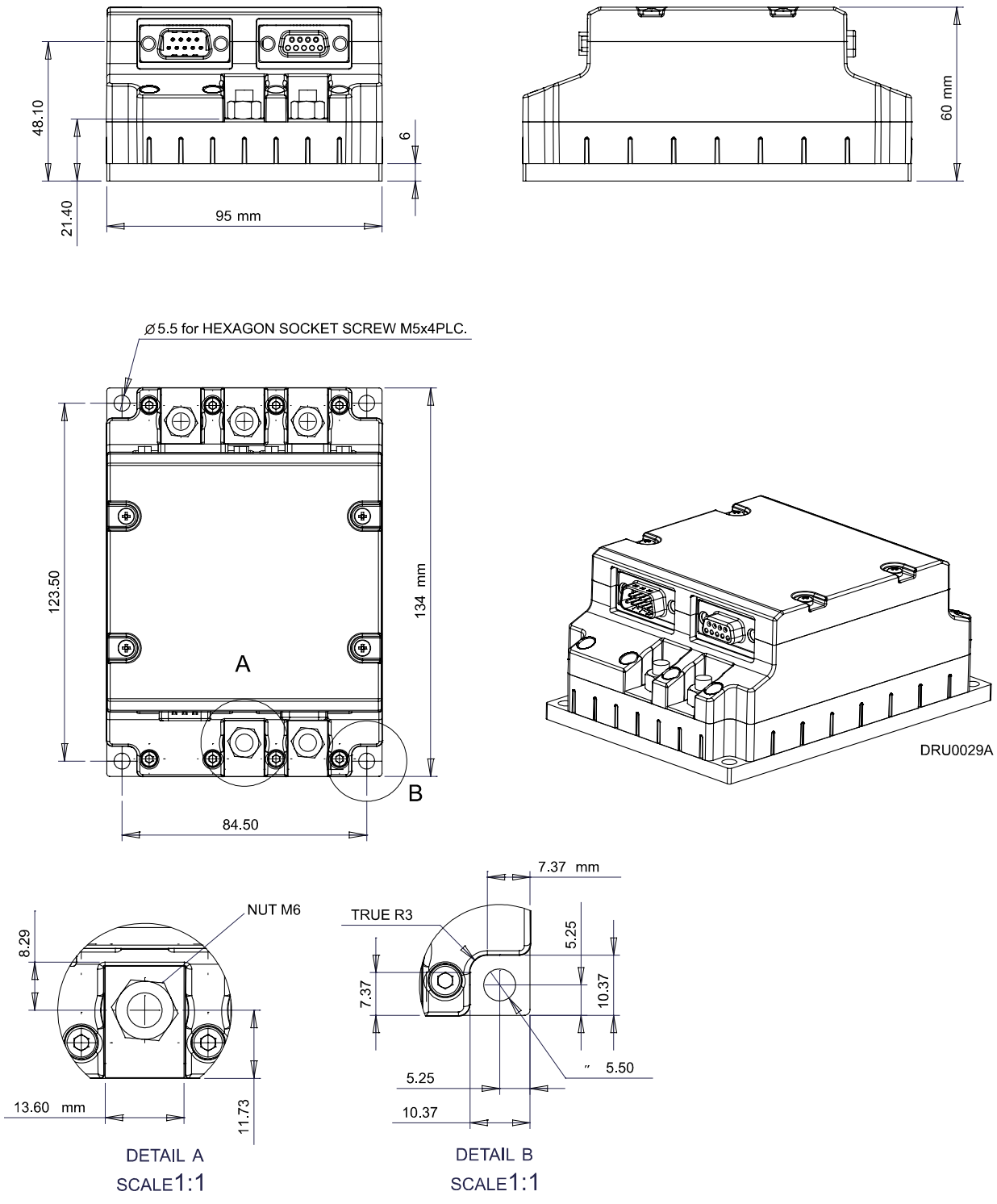


Figure 3-1: ***Mounting the Drum***

3.4 Connecting the Cables

3.4.1 Wiring the Drum

Once the Drum is mounted, you are ready to wire the device. Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance of the Drum.

Follow these instructions to ensure safe and proper wiring:

- Use twisted pair shielded cables for control, feedback and communication connections. For best results, the cable should have an aluminum foil shield covered by copper braid, and should contain a drain wire.

  The drain wire is a non-insulated wire that is in contact with parts of the cable, usually the shield. It is used to terminate the shield and as a grounding connection.
- The impedance of the wire must be as low as possible. The size of the wire must be thicker than actually required by the carrying current. A 24, 26 or 28 AWG wire for control and feedback cables is satisfactory although 24 AWG is recommended.
- Use shielded wires for motor connections as well. If the wires are long, ensure that the capacitance between the wires is not too high: C < 30 nF is satisfactory for most applications.
- Keep all wires and cables as short as possible.
- Keep the motor wires as far away as possible from the feedback, control and communication cables.
- Ensure that in normal operating conditions, the shielded wires and drain *carry no current*. The only time these conductors carry current is under abnormal conditions, when electrical equipment has become a potential shock or fire hazard while conducting external EMI interferences directly to ground, in order to prevent them from affecting the drive. Failing to meet this requirement can result in drive/controller/host failure.
- After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.

The following connectors are used for wiring the Drum.

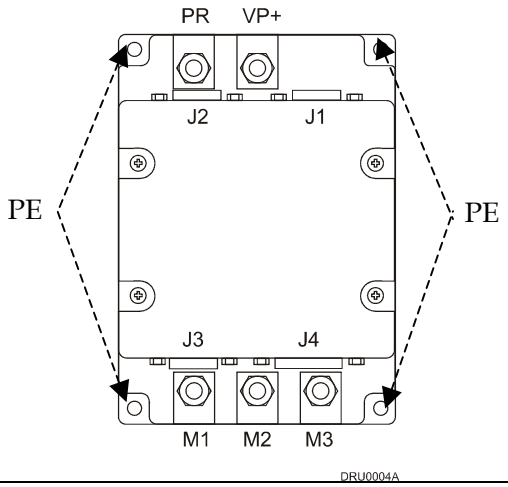
Type	Function	Port	Connector Location
Barrel Connector + M6 Spring Washer + M6 Nut	Power	VP+, PR	
	Motor	M1, M2, M3	
Barrel Connector + M5 Flat Washer + M5 Spring Washer + M5 screw	Ground	PE, PE, PE, PE	

Table 3-1: ***Power Connectors on the Drum***

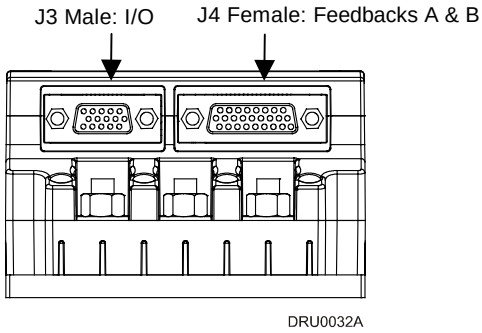
Type	Function	Port	Connector Location
26-pin high density D-Sub female	Feedbacks A & B	J4	
15-pin high density D-Sub male	Analog Input and General I/O	J3	

Table 3-2: ***Feedback and I/O Connectors on the Drum***

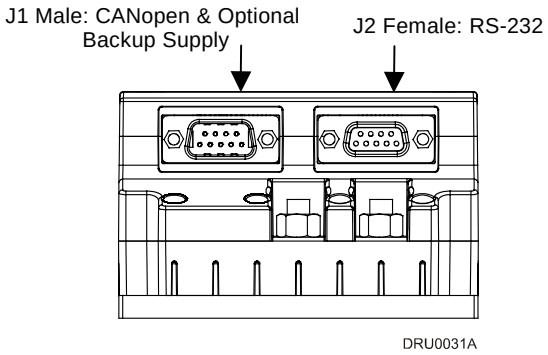
Type	Function	Port	Connector Location
9-pin D-Sub male	CANopen & Optional Backup Supply	J1	
9-pin D-Sub female	RS-232	J2	

Table 3-3: ***Communication and Backup Connectors on the Drum***

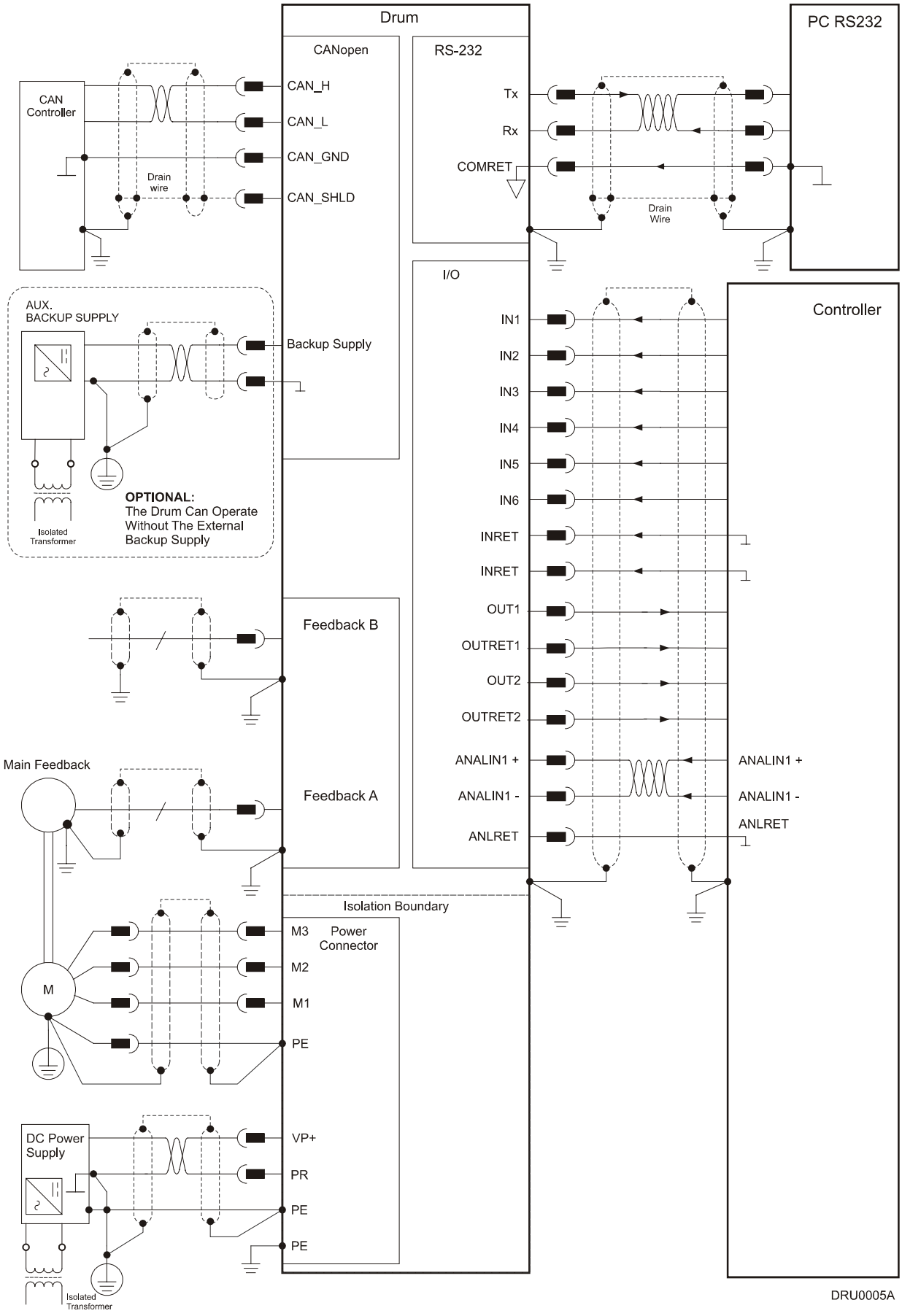
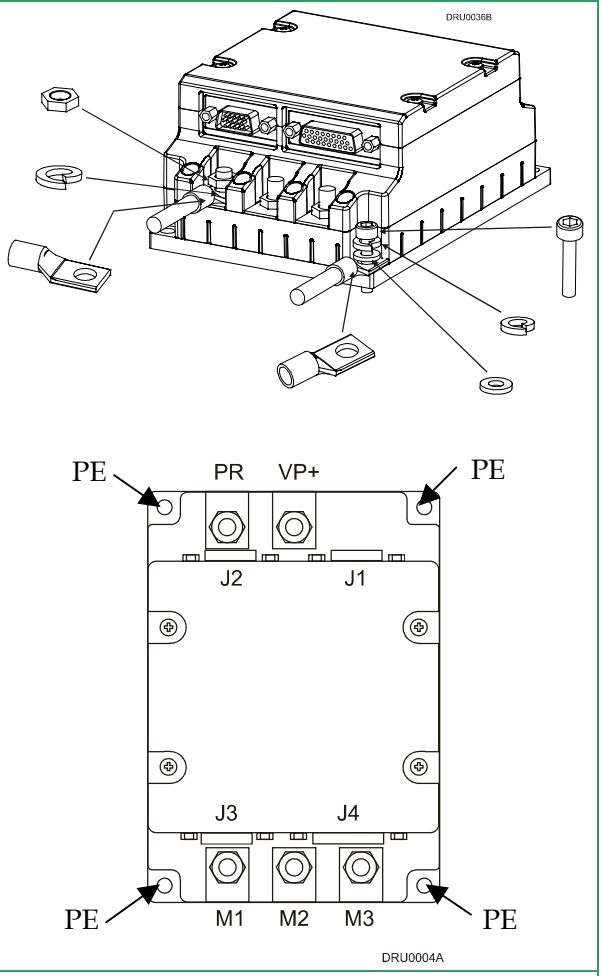


Figure 3-2: ***Drum Detailed Connection Diagram***

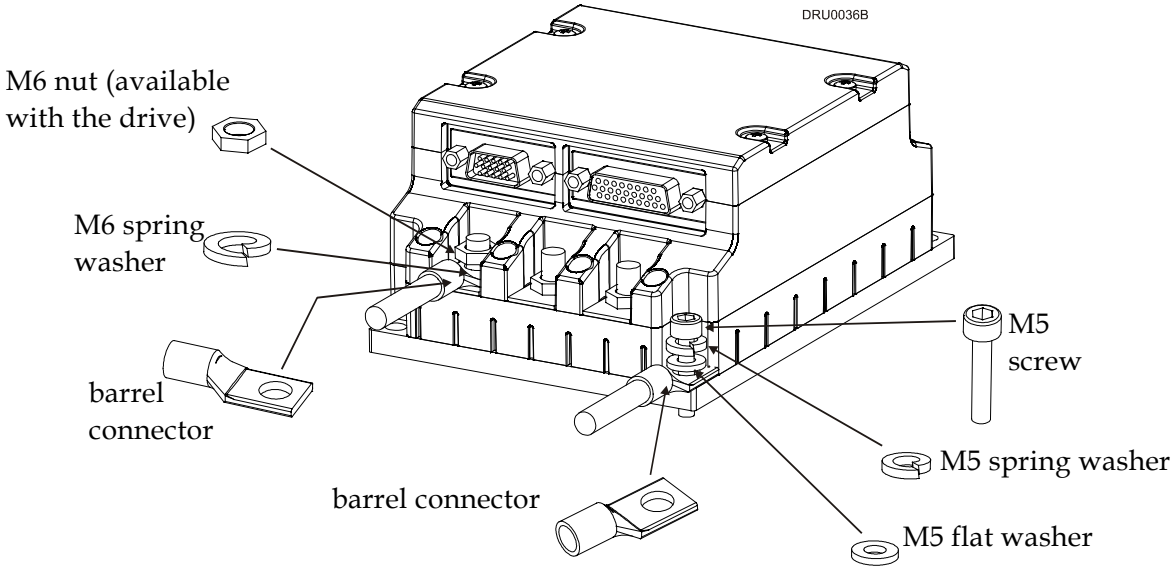
3.4.2 Connecting the Power Cables

The main power connector located at the bottom of the Drum, as follows:

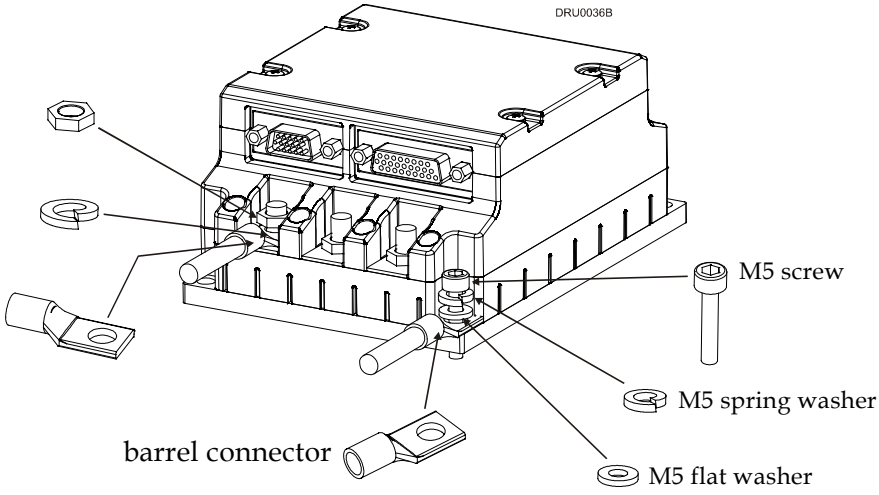
Pin	Function	Cable		Pin Positions
VP+	Pos. Power input	Power		
PR	Power return	Power		
PE	Protective earth	Power		
		3-Phase Motor Cable	**DC Motor Cable**	
PE	Protective earth	Motor	Motor	
M1	Motor phase	Motor	N/C	
M2	Motor phase	Motor	Motor	
M3	Motor phase	Motor	Motor	

When connecting several motors, all must be wired in an identical manner.

Table 3-4: ***Connector for Main Power and Motor Cables***



Step 1: PE Connection



Step 2: Power and Motor Connection

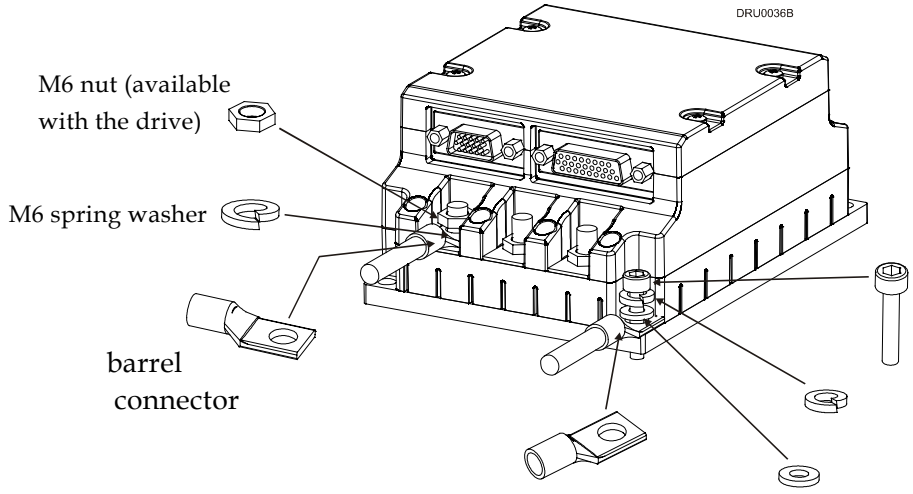


Table 3-5: ***Connecting the Main Power and Motor Cables***

3.4.2.1 Connecting the Motor Cable

Connect the motor power cable to the M1, M2, and M3 terminals of the main power connector and the fourth wire to the PE (Protective Earth) on the heat sink (see diagram above). The phase connection order is arbitrary because the Composer will establish the proper commutation automatically during setup.

Notes for connecting the motor cables:

- For best immunity, it is highly recommended to use a shielded (not twisted) cable for the motor connection. A 4-wire shielded cable should be used. The gauge is determined by the actual current consumption of the motor.
- Connect the shield of the cable to the closest ground connection at the motor end.
- Connect the shield of the cable to the PE terminal on the Drum.
- Be sure that the motor chassis is properly grounded.
- To close the motor cable into the drive, use the barrel connector, M6 spring washer and M6 nut (in the drive). The required torque is 3-4 Nm.
- To close the PE wire into the drive, use the barrel connector, M5 flat washer, M5 spring washer and M5 screw to the heatsink. The required torque is 3-4 Nm.

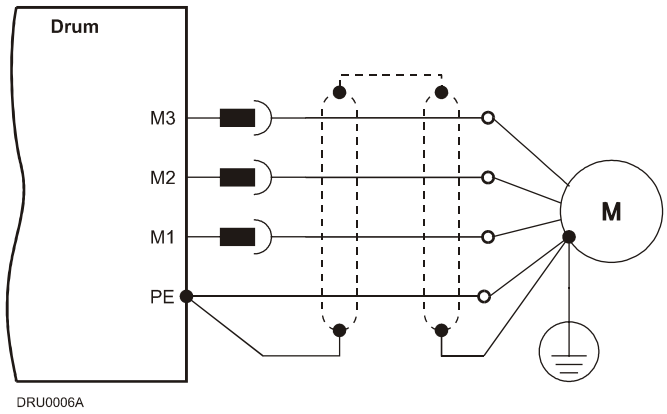


Figure 3-3: ***AC Motor Power Connection Diagram***

3.4.2.2 Connecting the DC Power

The Power stage of the Drum is fully isolated from other sections of the Drum, such as the control stage and the heatsink. This contributes very significantly to the safety and the EMI immunity of the Drum. In addition it simplifies the requirements of the DC power supply used to power the DC bus of the Drum and allows also the operation with a non-isolated DC power source.

Operation with an Isolated DC power Supply:

The PE (Protective Ground of the AC network) is connected to the PR terminal [The negative power terminal (-)].

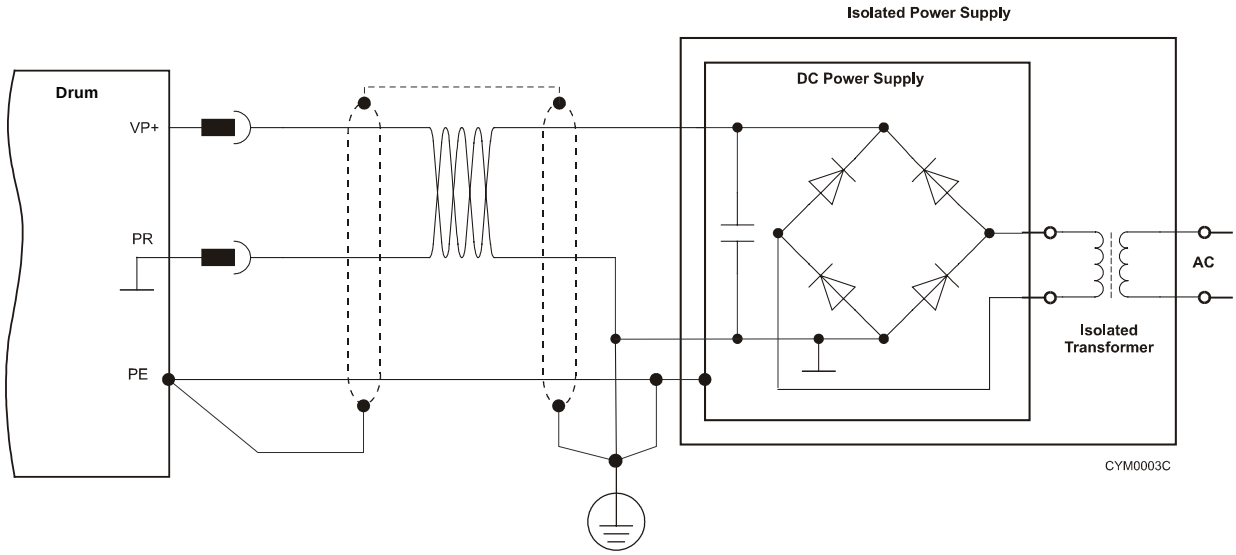


Figure 3-4: ***Isolated DC Power Supply***

In this case the isolation is achieved by the isolation transformer.

It is highly recommended to connect the network PE to the Return (negative terminal) of the Power Supply.

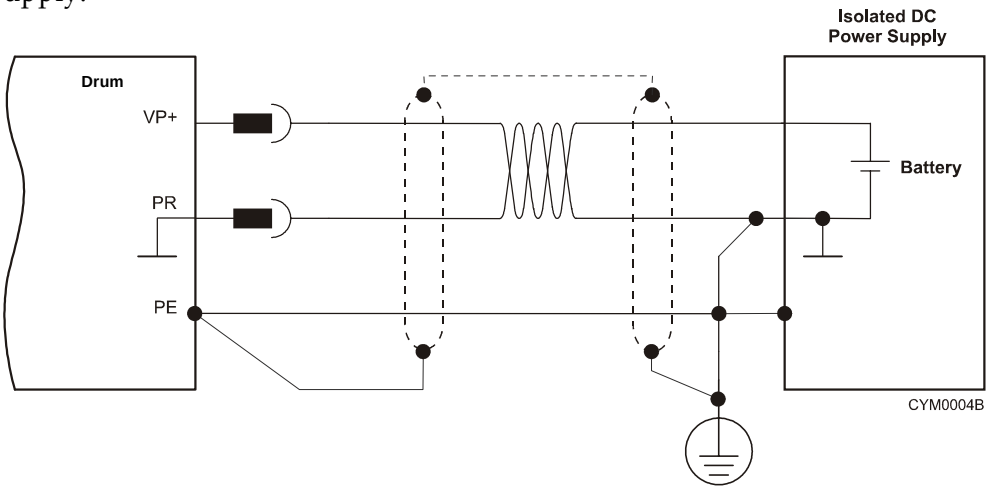


Figure 3-5: Isolated Power Supply

In this case the isolation is achieved by using a battery.

It is highly recommended to connect the PE to the Return (negative terminal) of the Power Supply.

Operation with a NON- Isolated DC power Supply:

The PE (Protective Ground of the AC network) **MUST NOT** be connected to the Return [PR terminal, the negative power terminal (-)] of the Drum.

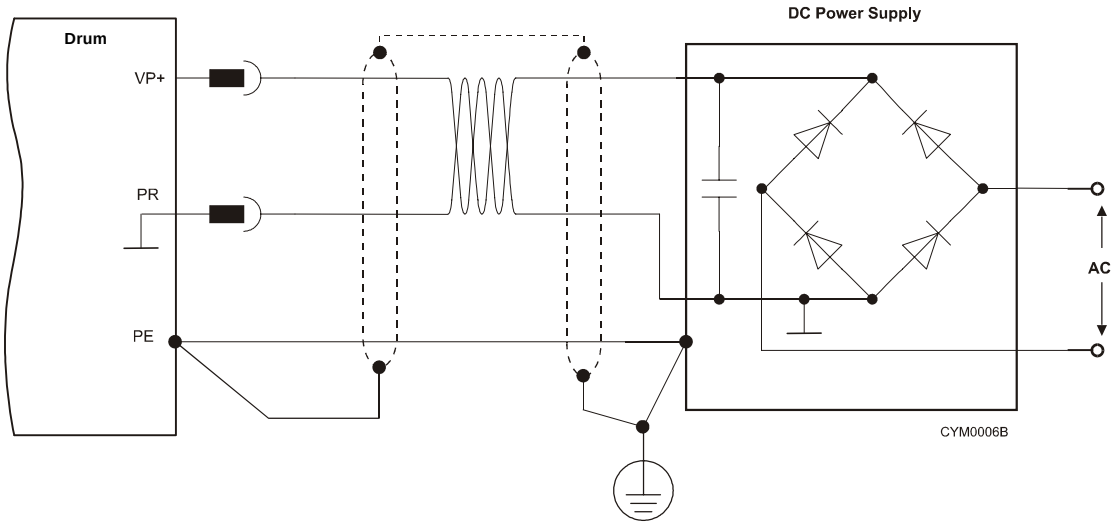


Figure 3-6: ***Non-Isolated DC Power Supply***

The Power Supply is directly connected to the AC line (The AC must be limited to 135 VAC not to exceed the max 190 VDC in case of 200 VDC drive).

The network PE **MUST NOT** be connected to the Return of the Power Supply.

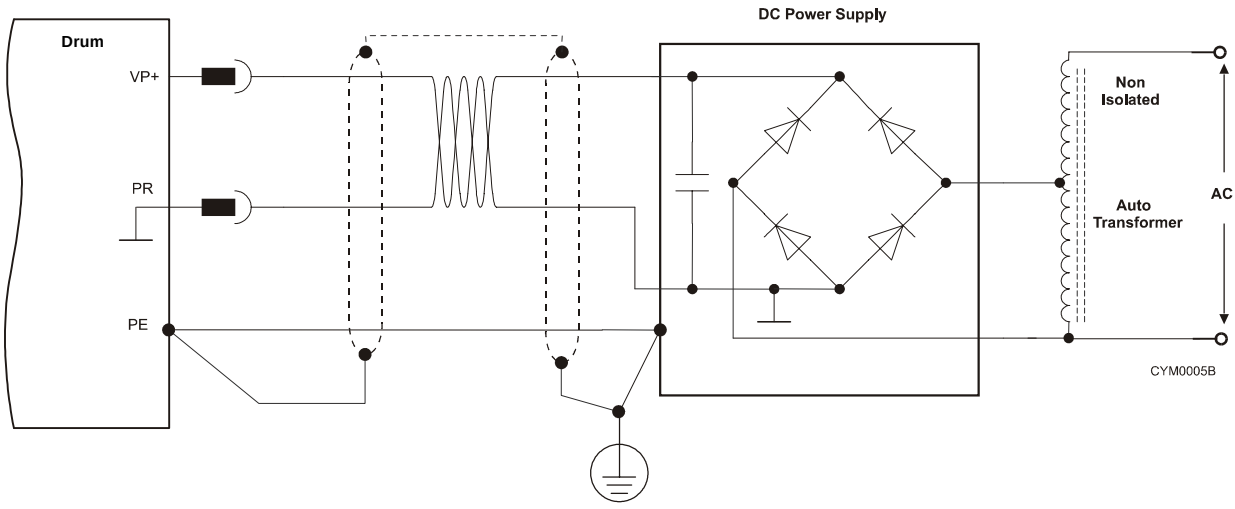


Figure 3-7: ***Non-Isolated DC Power Supply***

The Power Supply is directly connected to the AC line through an Autotransformer.

The network PE **MUST NOT** be connected to the Return of the Power Supply.

Warning: Connecting the PE to the PR with a non- isolated power supply will cause damages to the system (Any component that is connected to the system might be damaged).

Notes for connecting the DC power supply:

- Be aware: The Drum can operate from either an:
  - isolated DC power supply

    or
  - non-isolated DC power supply
- For best immunity, it is highly recommended to use twisted cables for the DC power supply cable. A 3-wire shielded cable should be used. The gauge is determined by the actual current consumption of the motor.
- Connect both ends of the cable shield to the closest ground connection, one end near the power supply and the other end to the PE terminal on the Drum's heatsink.
- For safety reasons connect the PR of the power supply to the closest ground connection.
- To close the power supply cable into the drive, use the barrel connector, M6 spring washer and M6 nut (in the drive). The required torque is 3-4 Nm.
- To close the PE wire into the drive, use the barrel connector, M5 flat washer, M5 spring washer and M5 screw to the heatsink. The required torque is 3-4 Nm.

3.4.2.3 Connecting the Optional Back-up Supply Cable

Power to the Drum is provided by a 12 to 195 VDC source (depending on model type). A "smart" control-supply algorithm enables the Drum to operate with the power supply only, *with no need for an auxiliary supply voltage*. If backup functionality is required for storing control parameters in case of power-outs, an external 12-195 VDC power supply can be connected, providing maximum flexibility and optional backup functionality when needed.

To connect the back-up supply to the Auxiliary port, use the Drum's J1 connector (CAN communication connector). *Remember, you are working with DC power so be sure to exercise caution.*

Notes for back-up supply connections:

- Use a 24 AWG twisted pair shielded cable. The shield should have copper braid.
- The source of the back-up supply must be isolated.
- For safety reasons, connect the return of the back-up supply source to the closest ground.
- Connect the cable shield to the closest ground near the power source.
- Before applying power, first verify the polarity of the connection.

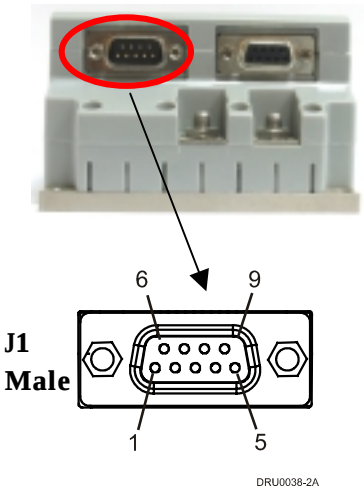
Pin	Signal	Function	Pin Position
J1-9	+VDC Backup Supply	+VDC back-up supply	
J1-8	RET Backup Supply	Return (common) of the back-up supply	

Table 3-6: ***Back-up Cable Plug***

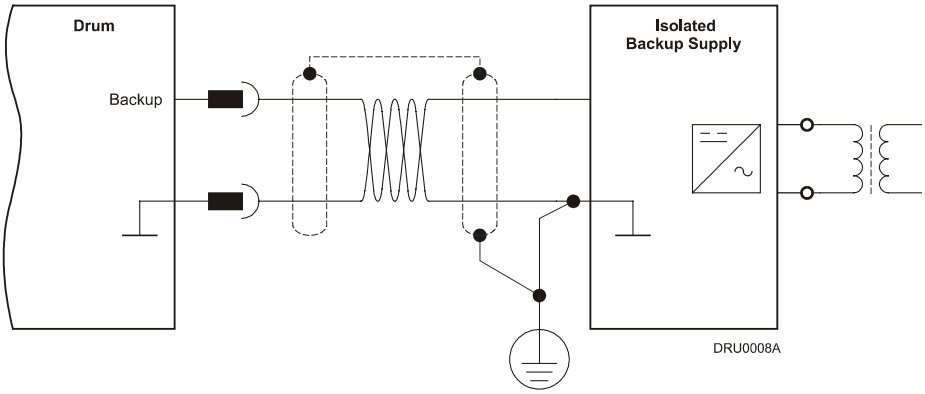


Figure 3-8: ***Back-up Supply Connection Diagram***

"Smart" Control Supply Options	Internal DC-to-DC converter allowing for operation from DC power (no need for auxiliary external supply for normal operation).
	12-195 VDC supply for backing up the control parameters if DC power is shut off.

3.4.3 Feedback Control and Communication Cable Assemblies

The Drum features easy-to-use D-sub type connections for all Control and Feedback cables. Below are instructions and diagrams describing how to assemble those cables.

- Use 24, 26 or 28 AWG twisted-pair shielded cables (24 AWG cable is recommended). For best results, the shield should have aluminum foil covered by copper braid.

- Use only a D-sub connector with a **metal housing**.
- Attach the braid shield tightly to the metal housing of the D-type connector.
- On the motor side connections, ground the shield to the motor chassis.
- On controller side connections, follow the controller manufacturer's recommendations concerning the shield.

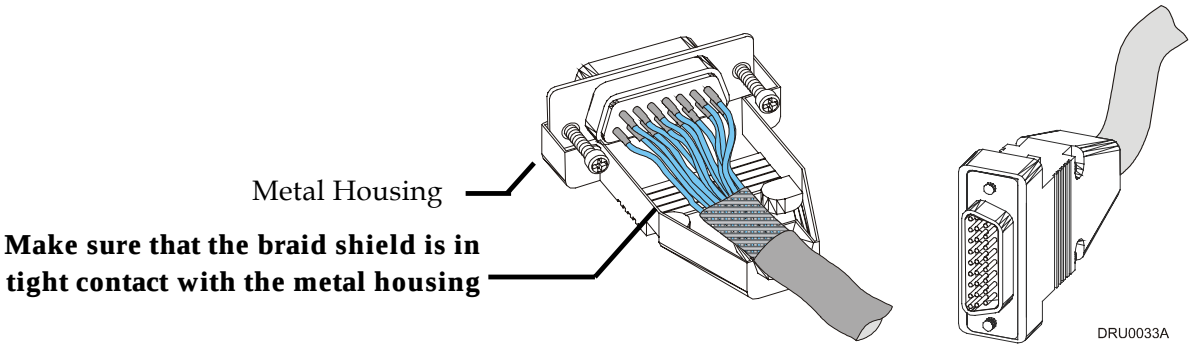


Figure 3-9: ***Feedback and Control Cable Assemblies***

Note: All D-sub type connectors, used with the Drum, should be assembled in this way.

3.4.4 Main Feedback Cable (FEEDBACK A)

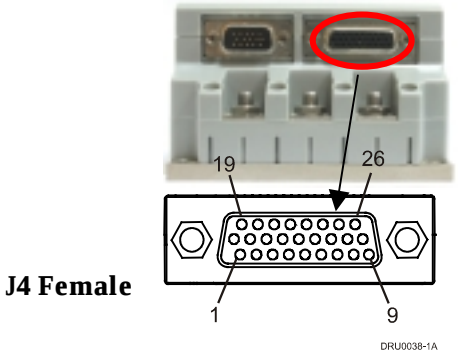
The main feedback cable is used to transfer feedback data from the motor to the drive.

The Drum accepts the following as a main feedback mechanism:

- Incremental encoder only
- Incremental encoder with digital Hall sensors
- Digital Hall sensors only
- Incremental Analog (Sine/Cosine) encoder (option)
- Resolver (option)
- Tachometer & Potentiometer
- Absolute Encoder

FEEDBACK A on the "front" of the Drum has a 26-pin high density D-sub socket. Connect the Main Feedback cable from the motor to FEEDBACK A using a 26-pin, high density D-Sub plug with a metal housing. When assembling the Main Feedback cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

Note: the Feedback connector also supports Feedbacks A and B.



J4 Female

		Incremental Encoder		**Interpolated Analog Encoder**		**Resolver**		**Tachometer and Potentiometer**	
		DRU XX/YYY_		**DRU XX/YYYI**		**DRU XX/YYYR**		**DRU XX/YYYT**	
Pin	**Port**	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**
1	A– Main Input	CHA	Channel A	A+	Sine A	S1	Sine A	Tac1+	Tacho Input 1 Pos. (20 V max)
2	A– Main Input	CHA-	Channel A Complement	A-	Sine A Complement	S3	Sine A Complement	Tac1-	Tacho Input 1 Neg. (20 V max)
3	A– Main Input	CHB	Channel B	B+	Cosine B	S2	Cosine B	Tac2+	Tacho Input 2 Pos. (50 V max)
4	A– Main Input	CHB-	Channel B Complement	B-	Cosine B Complement	S4	Cosine B Complement	Tac2-	Tacho Input 2 Neg. (50 V max)
5	A– Main Input	INDEX	Index	R+	Reference	R1	Vref f=1/TS, 50mA Max.	POT	Potentio-meter Input
6	A– Main Input	INDEX-	Index Complement	R-	Reference Complement	R2	Vref complement f= 1/TS, 50 mA Max.	NC	-
7	Hall A	HA	Hall sensor A input	HA	Hall sensor A input	HA	Hall sensor A input	HA	Hall sensor A input
8	Hall B	HB	Hall sensor B input	HB	Hall sensor B input	HB	Hall sensor B input	HB	Hall sensor B input
9	Hall C	HC	Hall sensor C input	HC	Hall sensor C input	HC	Hall sensor C input	HC	Hall sensor C input
10	B2 – Aux. Output	CHAO	Aux./Main channel A high output	CHAO	Aux./ Emulated channel A high output	CHAO	Aux./ Emulated channel A high output	CHAO	Aux./ Emulated channel A high output
11	B2 – Aux. Output	CHAO-	Aux./Main channel A low output	CHAO-	Aux./ Emulated channel A low output	CHAO-	Aux./ Emulated channel A low output	CHAO-	Aux./ Emulated channel A low output
12	B2 – Aux. Output	CHBO	Aux./Main channel B high output	CHBO	Aux./ Emulated channel B high output	CHBO	Aux./ Emulated channel B high output	CHBO	Aux./ Emulated channel B high output

		Incremental Encoder		**Interpolated Analog Encoder**		**Resolver**		**Tachometer and Potentiometer**	
		DRU XX/YYY_		**DRU XX/YYYI**		**DRU XX/YYYR**		**DRU XX/YYYT**	
Pin	**Port**	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**
13	B2 – Aux. Output	CHBO-	Aux./Main channel B low output	CHBO-	Aux./ Emulated channel B low output	CHBO-	Aux./ Emulated channel B low output	CHBO-	Aux./ Emulated channel B low output
14	B2 – Aux. Output	INDEXO	Aux./Main INDEX high output	INDEXO	Aux. INDEX high output	INDEXO	Aux./ Emulated INDEX high output	INDEXO	Aux. INDEX high output
15	B2 – Aux. Output	INDEXO-	Aux./Main INDEX low output	INDEXO-	Aux. INDEX low output	INDEXO -	Aux./ Emulated INDEX low output	INDEXO-	Aux. INDEX low output
16	PWR	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return
17	PWR	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return
18	PWR	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return
19	B1 – Aux. Input/ Output	CHA	Main channel A high output/ Auxiliary channel A high input	CHA	Emulated channel A high output/ Auxiliary channel A high input	CHA	Emulated channel A high output/ Auxiliary channel A high input	CHA	Emulated channel A high output/ Auxiliary channel A high input
20	B1 – Aux. Input/ Output	CHA-	Main channel A low output/ Auxiliary channel A low input	CHA-	Emulated channel A low output/ Auxiliary channel A low input	CHA-	Emulated channel A low output/ Auxiliary channel A low input	CHA-	Emulated channel A low output/ Auxiliary channel A low input
21	B1 – Aux. Input/ Output	CHB	Main channel B high output/ Auxiliary channel B high input	CHB	Emulated channel B high output/ Auxiliary channel B high input	CHB	Emulated channel B high output/ Auxiliary channel B high input	CHB	Emulated channel B high output/ Auxiliary channel B high input

		Incremental Encoder		**Interpolated Analog Encoder**		**Resolver**		**Tachometer and Potentiometer**	
		DRU XX/YYY_		**DRU XX/YYYI**		**DRU XX/YYYR**		**DRU XX/YYYT**	
Pin	**Port**	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**
22	B1 – Aux. Input/ Output	CHB-	Main channel B low output/ Auxiliary channel B low input	CHB-	Emulated channel B low output/ Auxiliary channel B low input	CHB-	Emulated channel B low output/ Auxiliary channel B low input	CHB-	Emulated channel B low output/ Auxiliary channel B low input
23	B1 – Aux. Input/ Output	INDEX	Main INDEX high output/ Auxiliary INDEX high input	INDEX	Auxiliary INDEX high input	INDEX	Emulated INDEX high output/ Auxiliary INDEX high input	INDEX	Auxiliary INDEX high input
24	B1 – Aux. Input/ Output	INDEX-	Main INDEX low output/ Auxiliary INDEX low input	INDEX-	Auxiliary INDEX low input	INDEX-	Emulated INDEX low output/ Auxiliary INDEX low input	INDEX-	Auxiliary INDEX low input
25	PWR	+5V	Encoder/ Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/ Hall +5V supply	+5V	Encoder/ Hall +5V supply
26	PWR	+5V	Encoder/ Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/ Hall +5V supply	+5V	Encoder/ Hall +5V supply

Table 3-7: ***Feedback Cable Pin Assignments***

		Absolute Encoders			
		DRU XX/YYY			
Pin	**Port**	**Signal**	**Heidenhain 2.1**	**Signal**	**Stegmann**
1	A– Main Input	A+	Sine A	A-	Sine A Complement
2	A– Main Input	A-	Sine A Complement	A+	Sine A
3	A– Main Input	B+	Cosine B	B+	Cosine B
4	A– Main Input	B-	Cosine B Complement	B-	Cosine B Complement
5	A– Main Input	DATA+	Data	DATA+	Data
6	A– Main Input	DATA-	Data Complement	DATA-	Data Complement
7	Hall A	HA	Hall sensor A input	HA	Hall sensor A input
8	Hall B	HB	Hall sensor B input	HB	Hall sensor B input
9	Hall C	HC	Hall sensor C input	HC	Hall sensor C input
10	B2– Aux. Output	CHAO	Aux. / Emulated channel A high output	CHAO	Aux. channel A high output / Emulated channel A low output
11	B2– Aux. Output	CHAO-	Aux. / Emulated channel A low output	CHAO-	Aux. channel A low output / Emulated channel A high output
12	B2– Aux. Output	CHBO	Aux. / Emulated channel B high output	CHBO	Aux. / Emulated channel B high output
13	B2– Aux. Output	CHBO-	Aux. / Emulated channel B low output	CHBO-	Aux. / Emulated channel B low output
14	B2– Aux. Output	INDEXO	Aux. INDEX high output	INDEXO	Aux. INDEX high output
15	B2– Aux. Output	INDEXO-	Aux. INDEX low output	INDEXO-	Aux. INDEX low output
16		CLK+	Clock	N.A	Do not connect
17		CLK-	Clock Complement	N.A	Do not connect
18	PWR	SUPRET	Supply return	SUPRET	Supply return
19	B1– Aux. Input/ Output	CHA	Emulated channel A high output/Auxiliary channel A high input	CHA	Emulated channel A low output / Auxiliary channel A high input
20	B1– Aux. Input/ Output	CHA-	Emulated channel A low output/Auxiliary channel A low input	CHA-	Emulated channel A high output / Auxiliary channel A low input
21	B1– Aux. Input/ Output	CHB	Emulated channel B high output/Auxiliary channel B high input	CHB	Emulated channel B high output/ Auxiliary channel B high input

		Absolute Encoders			
		DRU XX/YYY			
Pin	**Port**	**Signal**	**Heidenhain 2.1**	**Signal**	**Stegmann**
22	B1– Aux. Input/ Output	CHB-	Emulated channel B low output/ Auxiliary channel B low input	CHB-	Emulated channel B low output/ Auxiliary channel B low input
23	B1– Aux. Input/ Output	INDEX	Auxiliary INDEX high input	INDEX	Auxiliary INDEX high input
24	B1– Aux. Input/ Output	INDEX-	Auxiliary INDEX low input	INDEX-	Auxiliary INDEX low input
25	PWR	+5V	Encoder/Hall +5V supply	+5V	+5V Hall supply
26	PWR	+8V	Do not connect	+8V	+8V Encoder supply

Table 3-7B: ***Feedback Cable Pin Assignments***

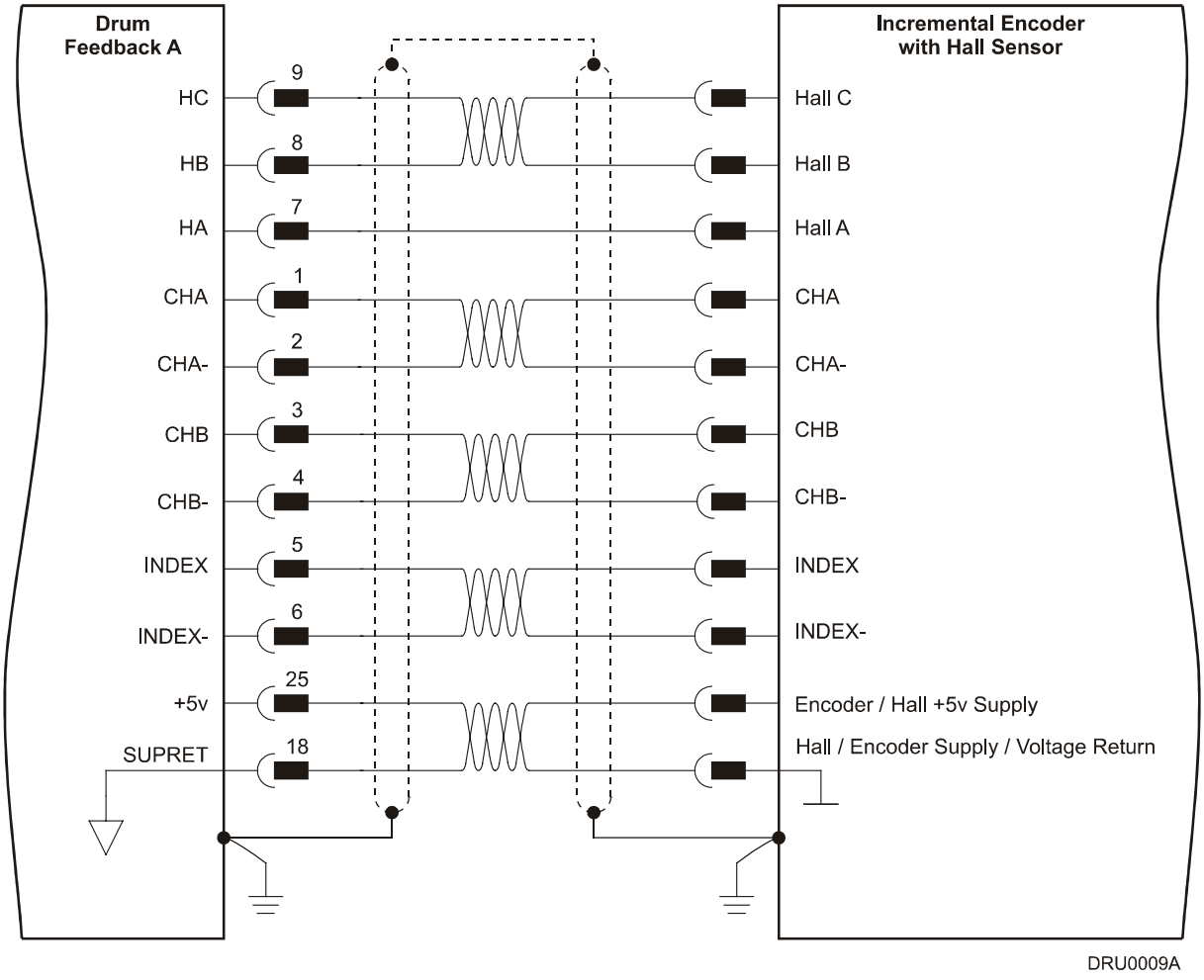


Figure 3-10: ***Main Feedback- Incremental Encoder Connection Diagram***

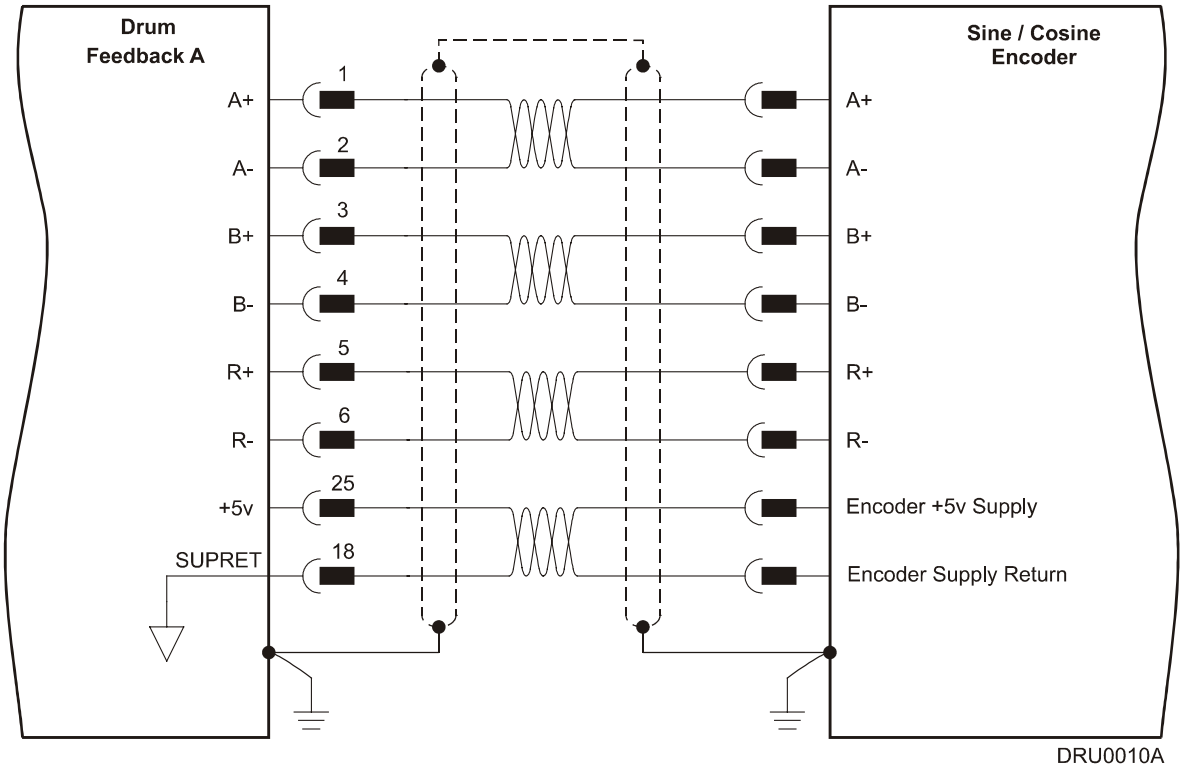


Figure 3-11: ***Main Feedback – Interpolated Analog Encoder Connection Diagram***

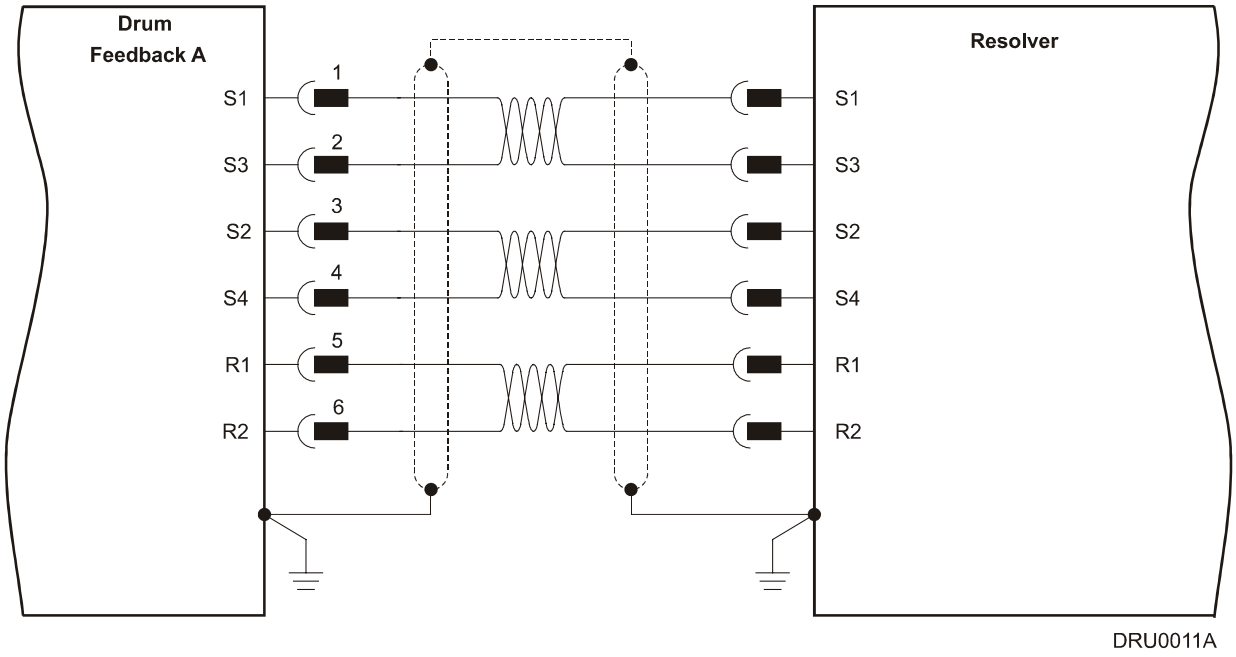


Figure 3-12: ***Main Feedback – Resolver Connection Diagram***

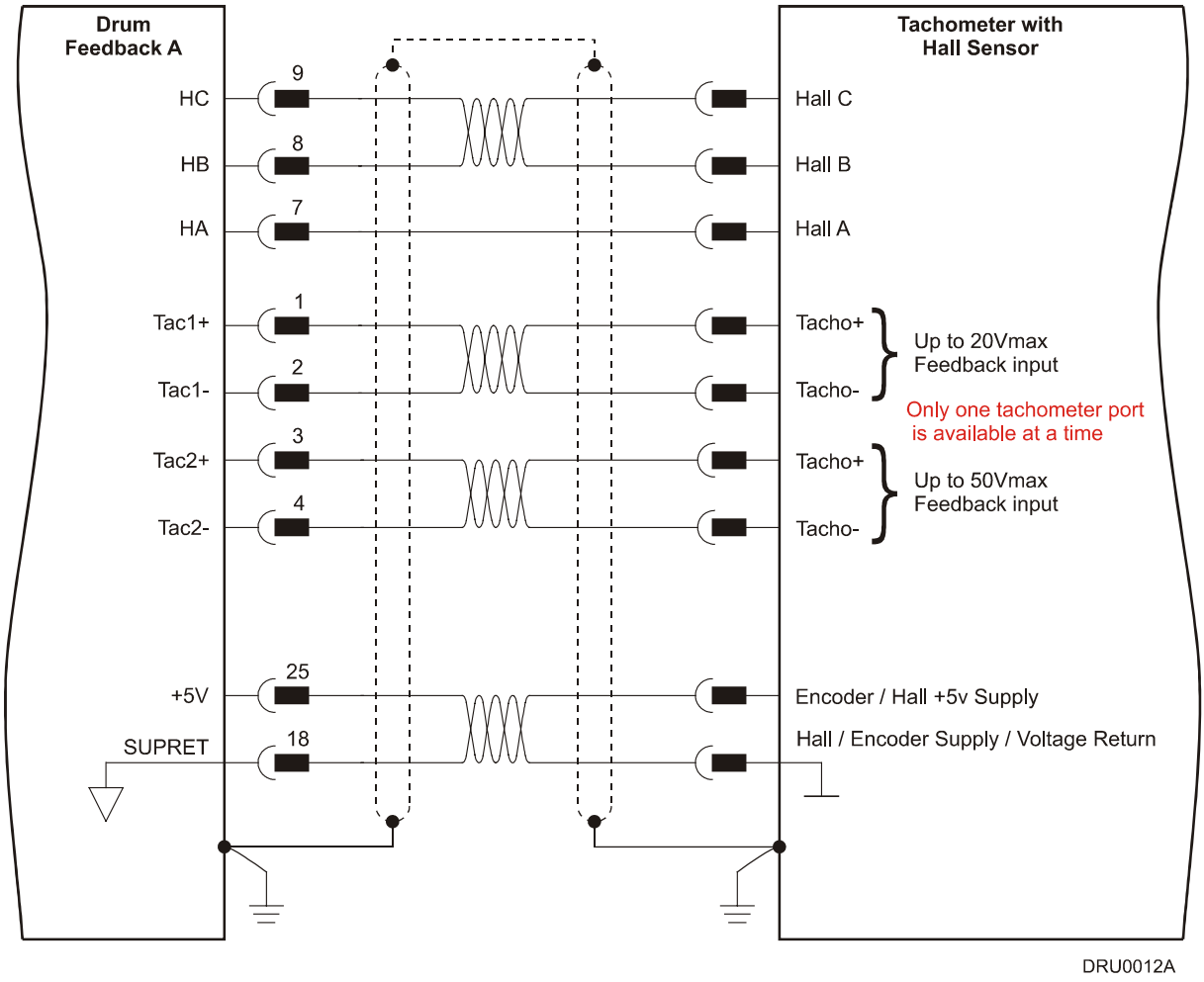


Figure 3-13: ***Main Feedback – Tachometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors***

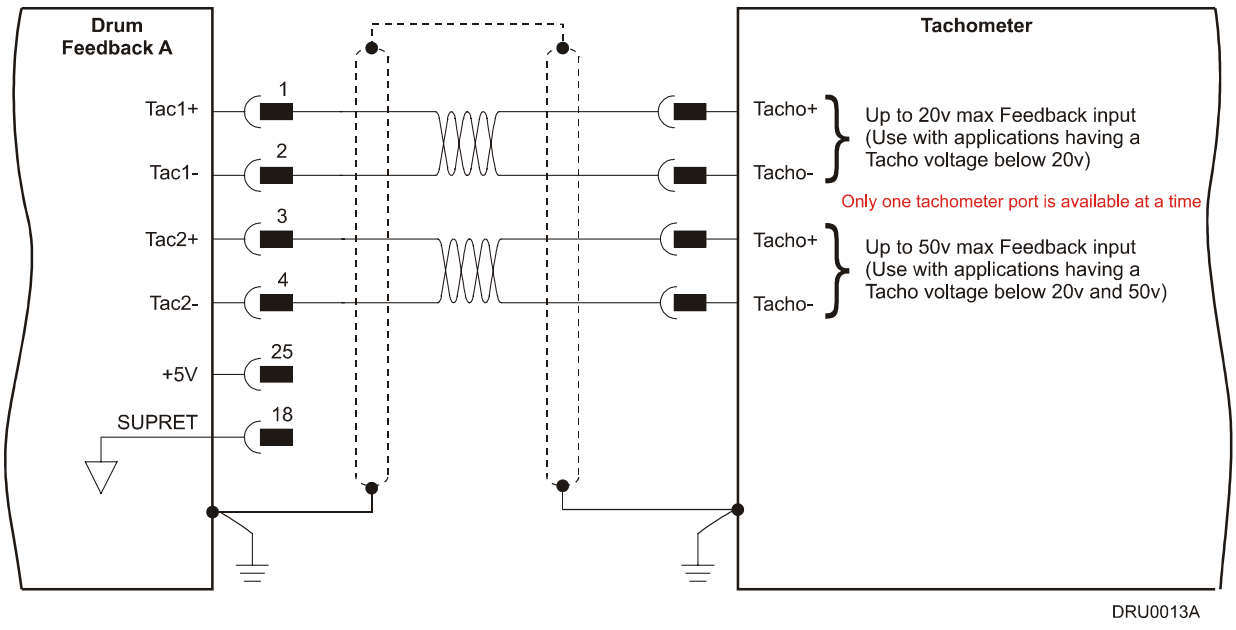


Figure 3-14: ***Main Feedback – Tachometer Feedback Connection Diagram for Brush Motors***

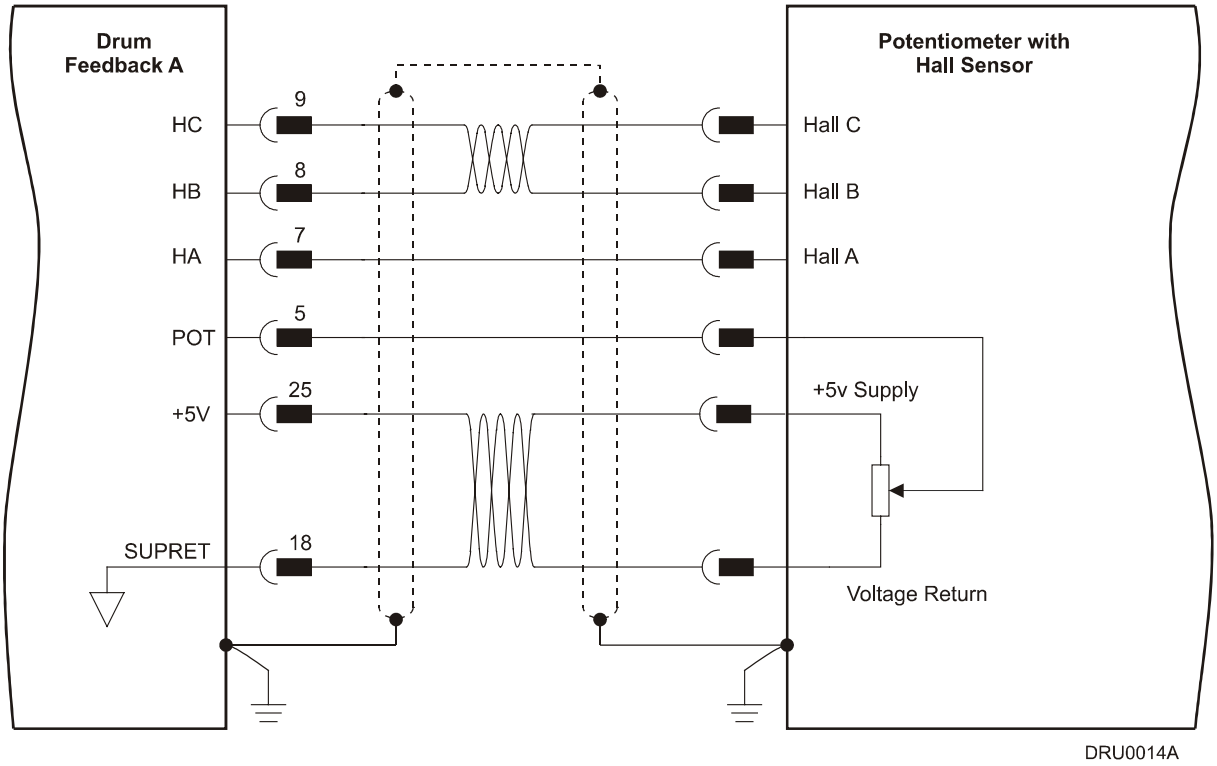


Figure 3-15: ***Main Feedback – Potentiometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors***

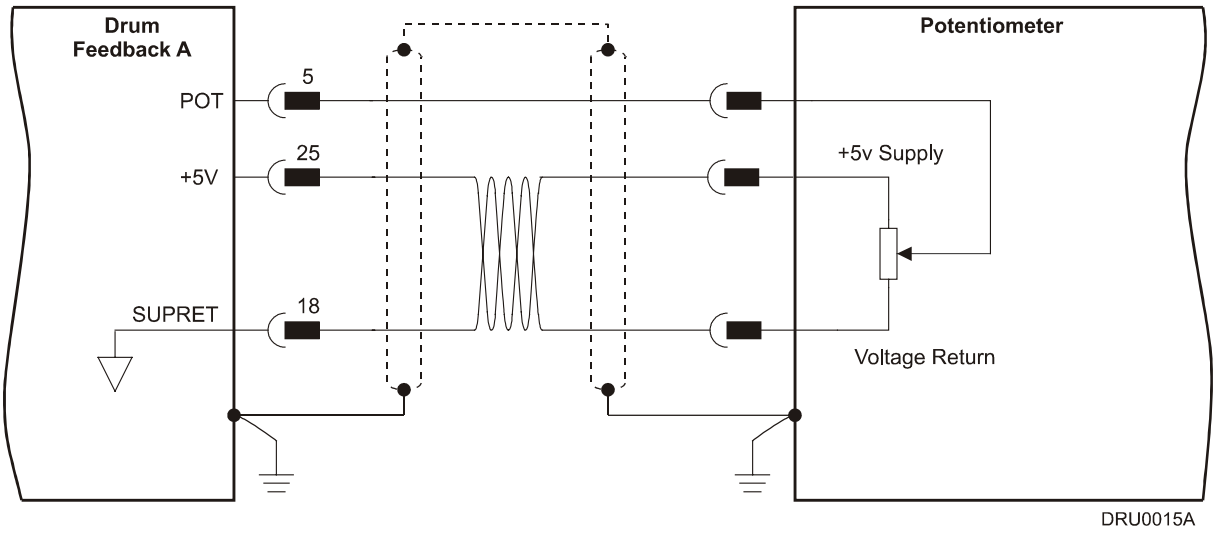


Figure 3-16: ***Main Feedback – Potentiometer Feedback Connection Diagram for Brush Motors and Voice Coils***

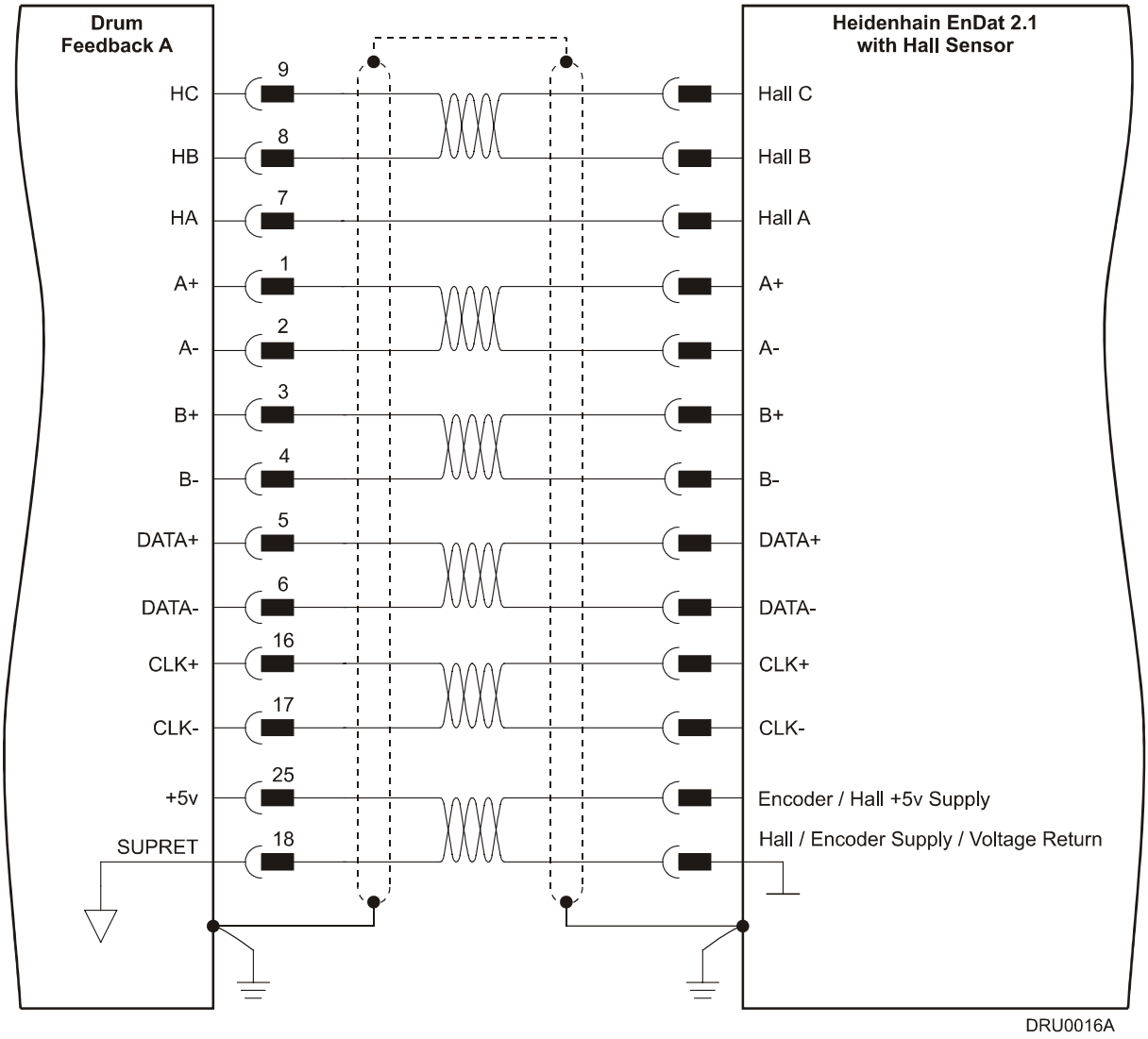


Figure 3-17: Main Feedback – Heidenhain (EnDat 2.1) Feedback with Hall Sensor Connection Diagram

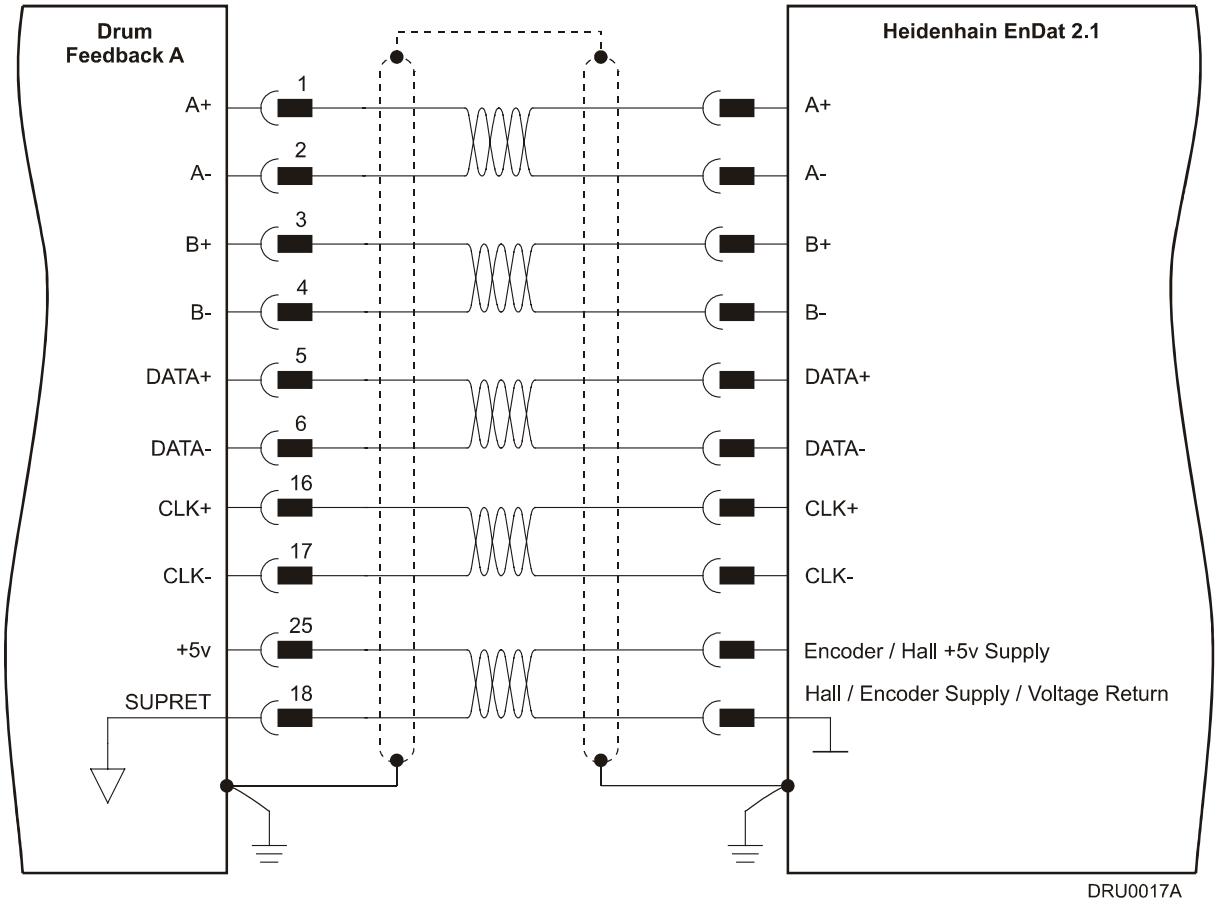


Figure 3-18: ***Main Feedback – Heidenhain (EnDat 2.1) Feedback Connection Diagram***

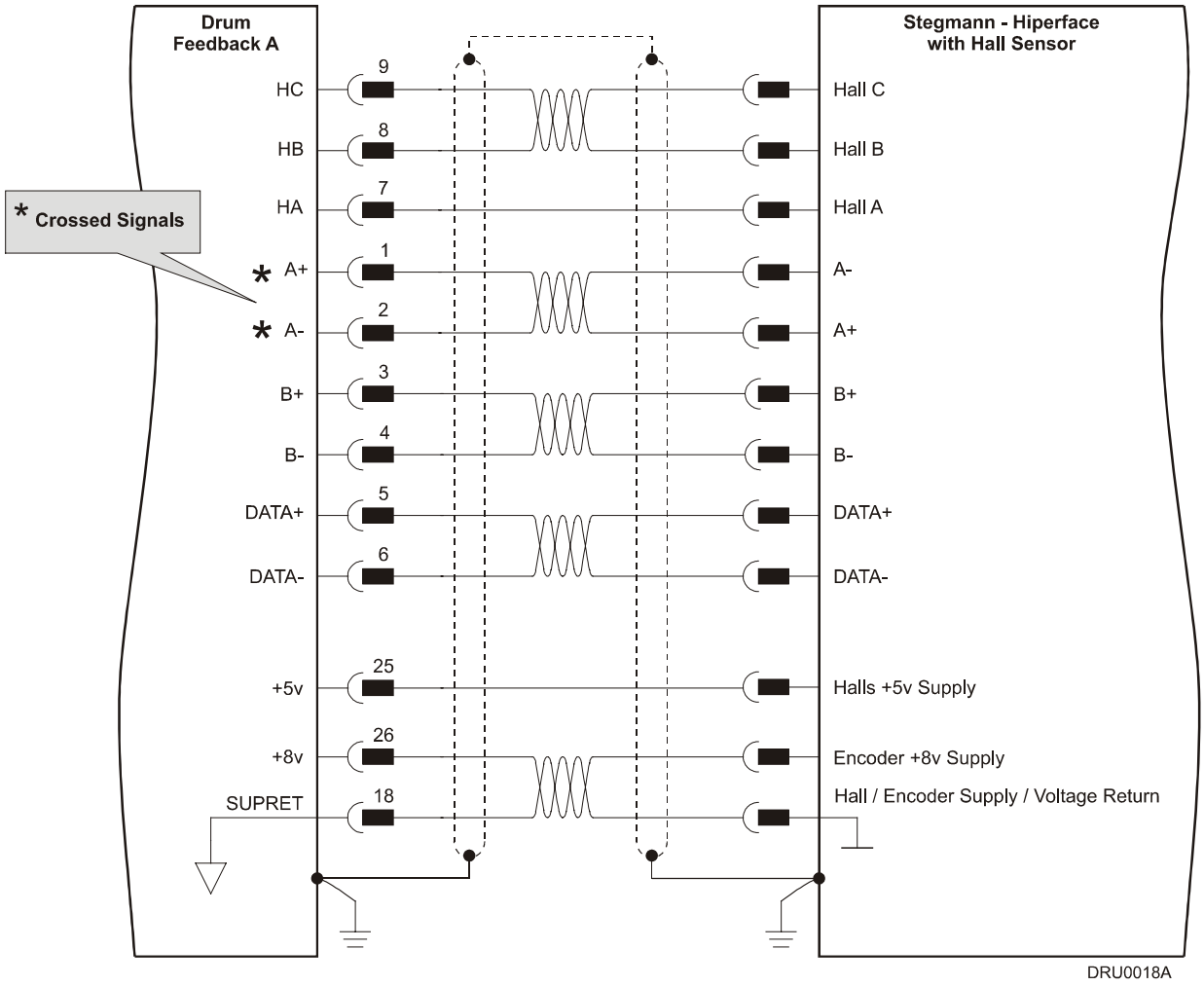


Figure 3-19: ***Main Feedback – Stegmann (Hiperface) Feedback with Hall Sensor Connection Diagram***

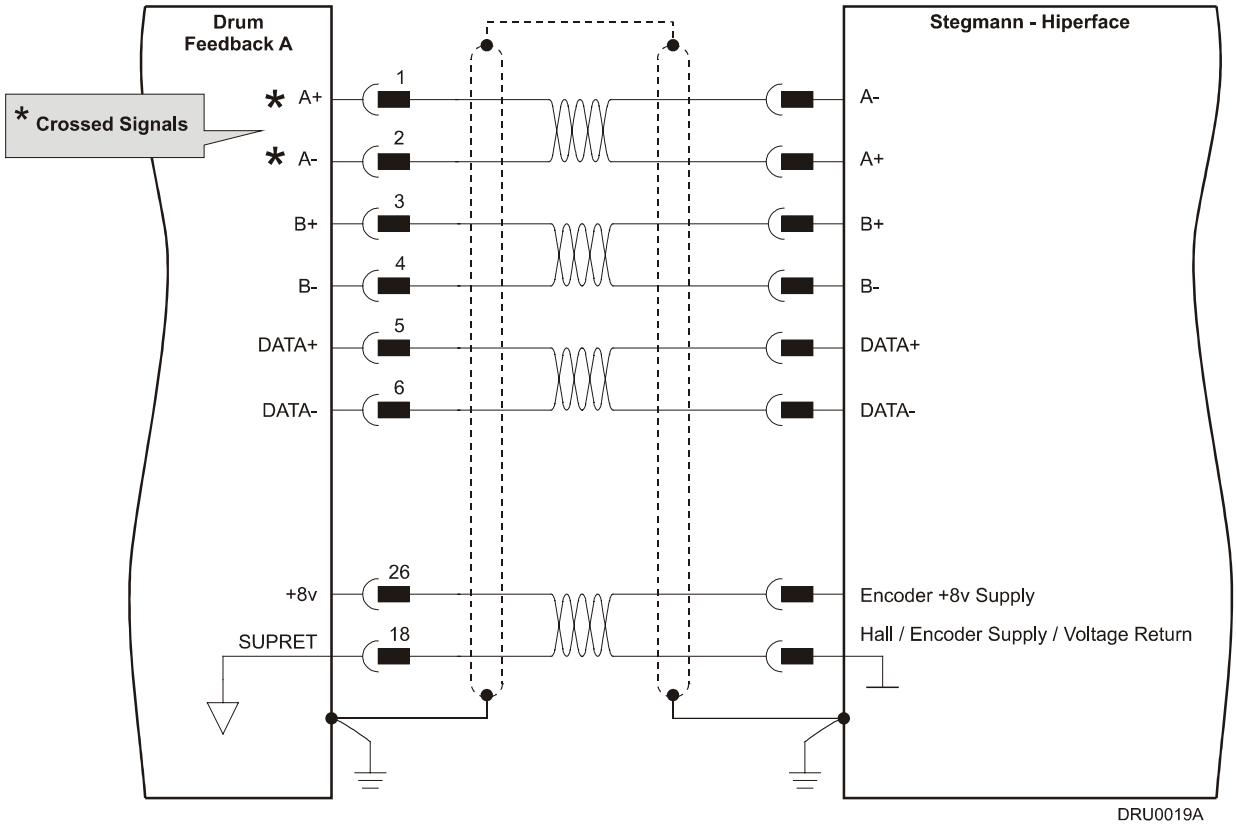
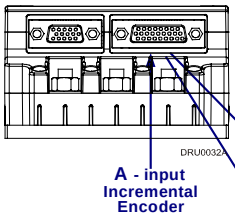
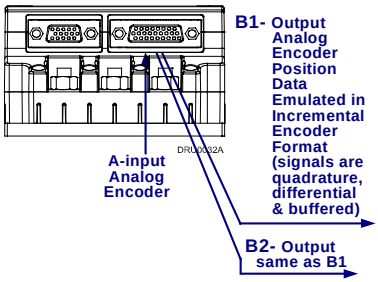
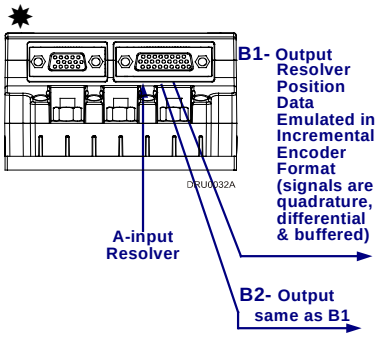
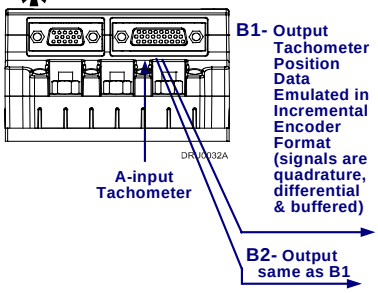
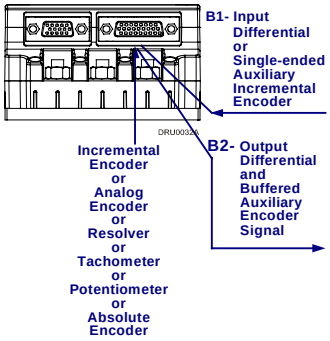


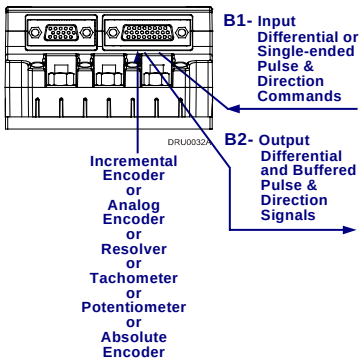
Figure 3-20: Main Feedback – Stegmann (Hiperface) Feedback Connection Diagram

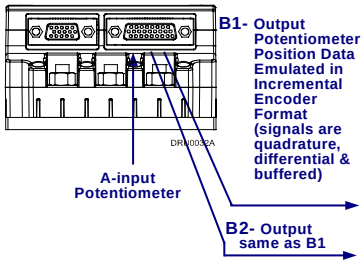
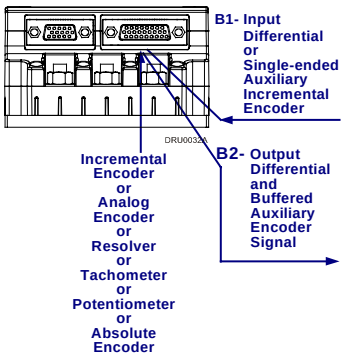
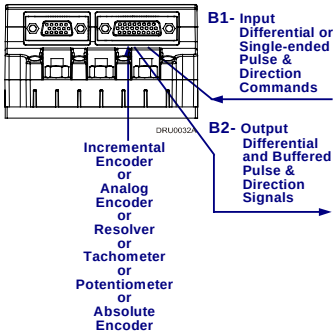
3.4.5 Main and Auxiliary Feedback Combinations

The Main Feedback is always used in motion control devices whereas Auxiliary Feedback is often, but not always used. The Auxiliary Feedback connector on the Drum, "FEEDBACK B" has two ports, Port B1 and Port B2. When used in combination with the Main Feedback port, "FEEDBACK A", the ports can be set, by software, as follows:

<table>
<tr><th>SW Setting
FEED-BACK A</th><th colspan="3">FEEDBACK B Ports B1 and B2</th></tr>
<tr><th></th><th>YA[4] = 4</th><th>YA[4] = 2</th><th>YA[4] = 0</th></tr>
<tr><td>Incremental Encoder Input</td><td>★
 
</td><td rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>Interpolated Analog (Sin/Cos) Encoder Input</td><td>★
 
</td></tr>
<tr><td>Resolver Input</td><td>✸
 
</td></tr>
<tr><td>Tachometer Input</td><td>✱
 
</td></tr>
</table>





SW Setting / FEED-BACK A	FEEDBACK B Ports B1 and B2		
	YA[4] = 4	**YA[4] = 2**	**YA[4] = 0**
Potentiometer Input	✧  	 	
Typical Applications	★ Any application where the main encoder is used, not only for the drive, but also for other purposes such as position controllers and/or other drives. ✶ Analog Encoder applications where position data is required in the Encoder's quadrature format. ✸ Resolver applications where position data is required in the Encoder's quadrature format. ✱ Tachometer applications where velocity data is required in the Encoder's quadrature format. ✧ Absolute Encoder applications where position data is required in the Encoder's quadrature format.	Any application where two feedbacks are used by the drive. Port B1 serves as an input for the auxiliary incremental encoder (differential or single-ended). Port B2 is used to output differential buffered Auxiliary Incremental Encoder signals. For applications such as Follower, ECAM, or Dual Loop.	Port B1 serves as an input for Pulse & Direction commands (differential or single-ended). Port B2 is used to output differential buffered Pulse & Direction signals.

3.4.6 Auxiliary Feedback (FEEDBACK B)

When using one of the auxiliary feedback options, the relevant functionality of FEEDBACK B ports are software selected for that option. Refer to the *SimplIQ Command Reference Manual* for detailed information about FEEDBACK B setup. When assembling the Main Feedback cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

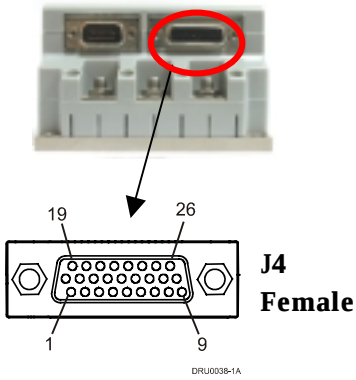
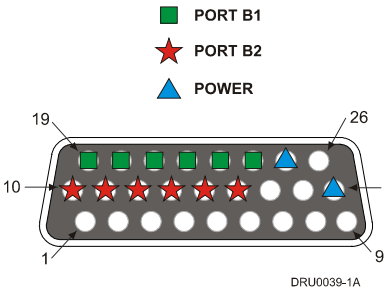
Note: the Feedback connector also supports Feedbacks A and B.

3.4.6.1 Main Encoder Buffered Outputs or Emulated Encoder Outputs Option on FEEDBACK B (YA[4]=4)

Through FEEDBACK B (Ports B1 and B2) the Drum can provide **two simultaneous buffered main, or emulated, encoder signals** to other controllers or drives. This option can be used when:

- The Drum is used as a current amplifier to provide position data to the position controller.
- The Drum is used in velocity mode, to provide position data to the position controller.
- The Drum is used as a master in Follower or ECAM mode.

Below are the signals on the Auxiliary Feedback ports when set up to run as a buffered outputs or emulated outputs of the main encoder (on FEEDBACK A):

Port	Pin	Signal	Function	Pin Position
B2	10	CHAO	Buffered channel A output	 **J4 Female**
B2	11	CHAO-	Buffered channel A complement output	
B2	12	CHBO	Buffered channel B output	
B2	13	CHBO-	Buffered channel B complement output	
B2	14	INDEXO	Buffered Index output	
B2	15	INDEXO-	Buffered Index complement output	 26 Pin high density D-sub Socket
PWR	18	SUPRET	Encoder supply voltage return/COMRET	
B1	19	CHA	Auxiliary channel A high *output*	
B1	20	CHA-	Auxiliary channel A low *output*	
B1	21	CHB	Auxiliary channel B high *output*	
B1	22	CHB-	Auxiliary channel B low *output*	
B1	23	INDEX	Auxiliary Index high *output*	
B1	24	INDEX-	Auxiliary Index low *output*	
PWR	25	+5V	Encoder supply voltage	

Note: In models not containing absolute encoder support, it is possible to use terminals 16 and 17 for SUPRET connections.

Table 3-8: ***Main Encoder Buffered Outputs or Emulated Encoder Outputs on FEEDBACK B - Pin Assignments***

FEEDBACK B on the "top" of the Drum has a 26-pin high density D-sub socket. Connect the Auxiliary Feedback cable, from the controller or other device, to FEEDBACK B using a 26-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

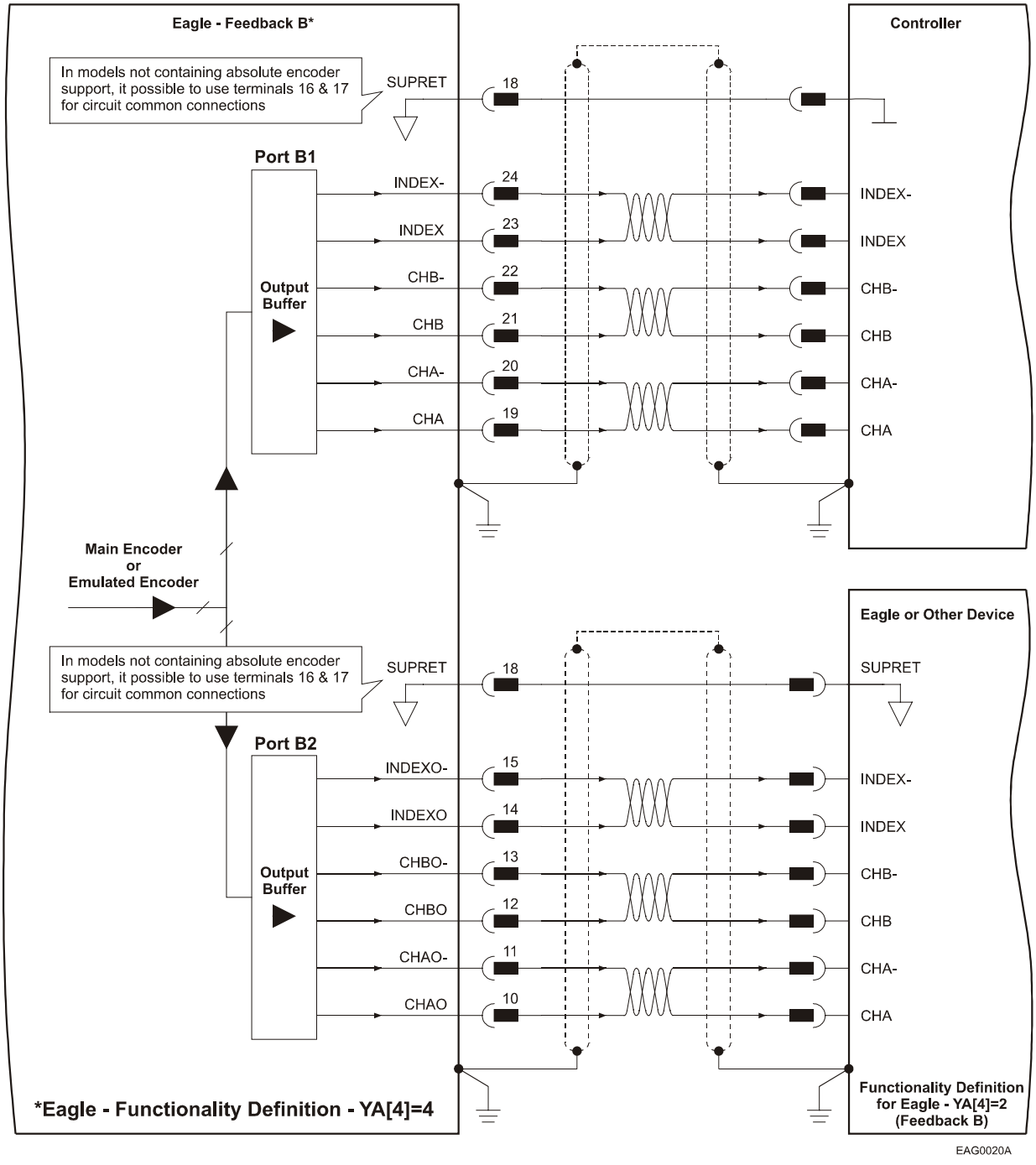
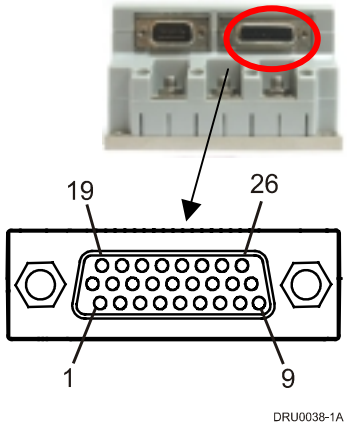
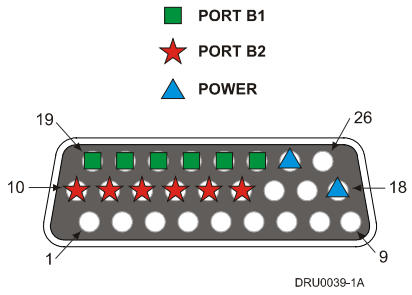


Figure 3-21: ***Main Encoder Buffered Output or Emulated Encoder Output on FEEDBACK B - Connection Diagram***

3.4.6.2 Differential Auxiliary Encoder Input Option on FEEDBACK B (YA[4]=2)

The Drum can be used as a slave by receiving the position of the master encoder data (on Port B1) in Follower or ECAM mode. In this mode Port B2 provides **differential buffered auxiliary outputs** for the next slave axis in follower or ECAM mode.

Below are the signals on the Auxiliary Feedback port when set up to run as a differential auxiliary encoder input:

Port	Pin	Signal	Function	Pin Position
B2	10	CHAO	Buffered channel A output	 **J4 Female**
B2	11	CHAO-	Buffered channel A complement output	
B2	12	CHBO	Buffered channel B output	
B2	13	CHBO-	Buffered channel B complement output	
B2	14	INDEXO	Buffered Index output	
B2	15	INDEXO-	Buffered Index complement output	
PWR	18	SUPRET	Encoder supply voltage return/COMRET	
B1	19	CHA	Auxiliary channel A high *input*	 26 Pin high density D-Sub Socket
B1	20	CHA-	Auxiliary channel A low *input*	
B1	21	CHB	Auxiliary channel B high *input*	
B1	22	CHB-	Auxiliary channel B low *input*	
B1	23	INDEX	Auxiliary Index high *input*	
B1	24	INDEX-	Auxiliary Index low *input*	
PWR	25	+5V	Encoder supply voltage	

Note: In models not containing absolute encoder support, it is possible to use terminals 16 and 17 for SUPRET connections and use terminal 26 for +5V connection.

Table 3-9: ***Differential Auxiliary Encoder Input Option on FEEDBACK B – Pin Assignments***

FEEDBACK B on the "top" of the Drum has a 26-pin high density D-sub socket. Connect the Auxiliary Feedback cable from the feedback device to FEEDBACK B using a 26-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

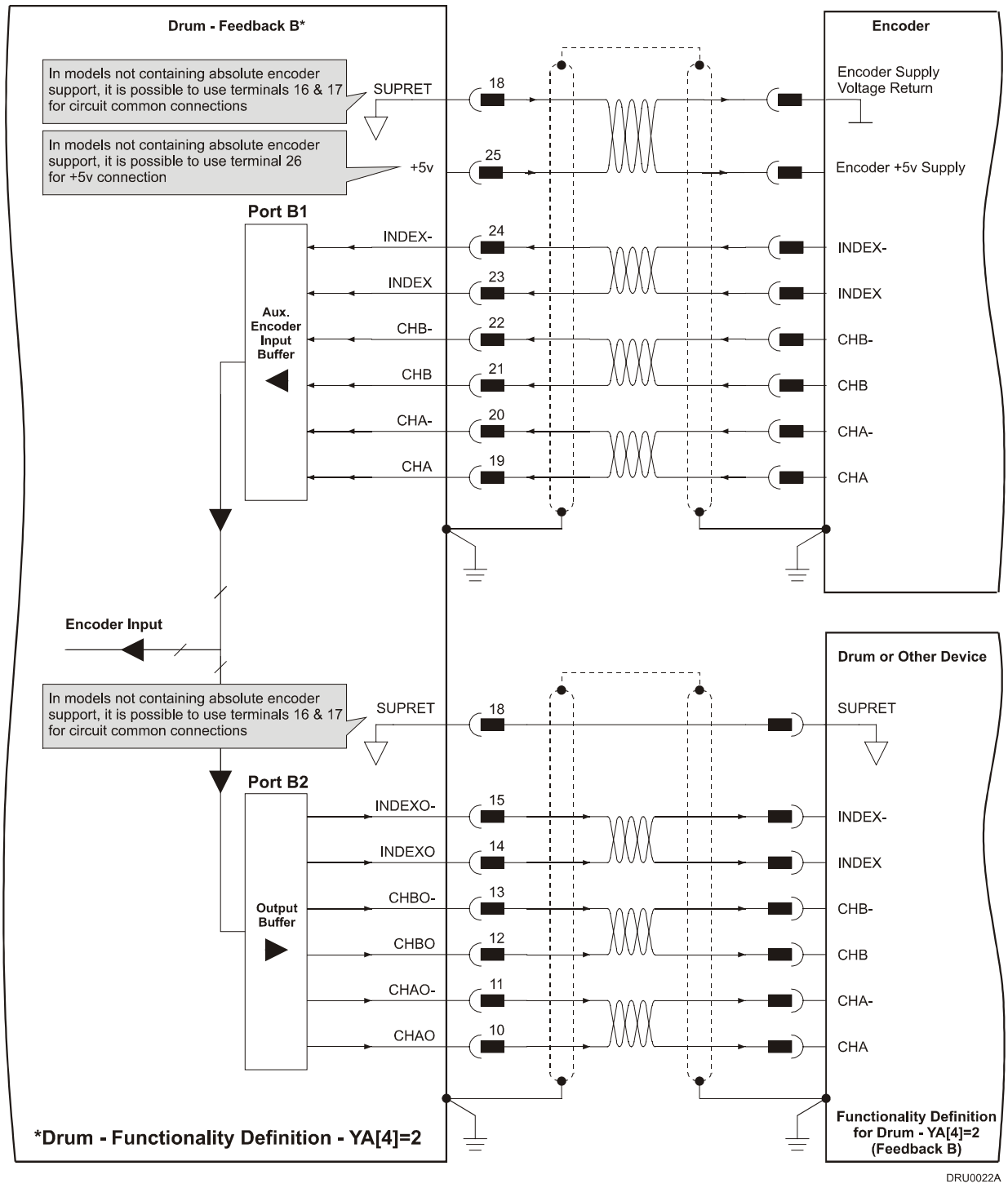
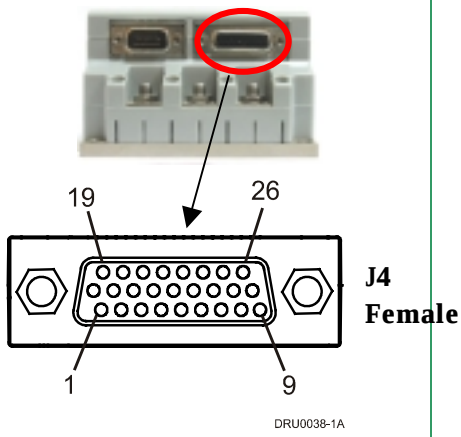
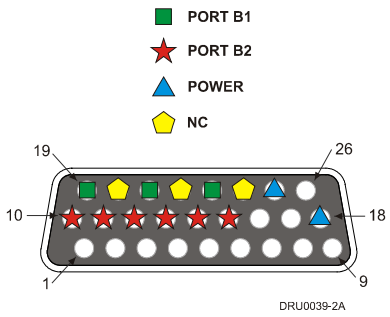


Figure 3-22: ***Differential Auxiliary Encoder Input Option on FEEDBACK B - Connection Diagram***

3.4.6.3 Single-ended Auxiliary Input Option on FEEDBACK B (YA[4]=2)

The Drum can be used as a slave by receiving the position data (on Port B1) of the master encoder in Follower or ECAM mode. In this mode Port B2 provides **differential buffered auxiliary outputs** for the next slave axis in Follower or ECAM mode.

Below are the signals on the Auxiliary Feedback ports when set up to run as a single-ended auxiliary input:

Port	Pin	Signal	Function	Pin Position
B2	10	CHAO	Channel A output	 **J4 Female** 26 Pin high density D-Sub Plug
B2	11	CHAO-	Channel A complement output	
B2	12	CHBO	Channel B output	
B2	13	CHBO-	Channel B complement output	
B2	14	INDEXO	Index output	
B2	15	INDEXO-	Index complement output	
PWR	18	SUPRET	Encoder supply voltage return/ COMRET	 26 Pin high density D-Sub Socket
B1	19	CHA	Auxiliary channel A high *input*	
	20	NC	Do not connect this pin	
B1	21	CHB	Auxiliary channel B high *input*	
	22	NC	Do not connect this pin	
B1	23	INDEX	Auxiliary Index high *input*	
	24	NC	Do not connect this pin	
PWR	25	+5V	Encoder supply voltage	

Note: In models not containing absolute encoder support, it is possible to use terminals 16 and 17 for SUPRET connections and use terminal 26 for +5V connection.

Table 3-10: ***Single-ended Auxiliary Encoder Option on FEEDBACK B - Pin Assignments***

FEEDBACK B on the "top" of the Drum has a 26-pin high density D-sub socket. Connect the Auxiliary Feedback cable from the feedback device to FEEDBACK B using a 26-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

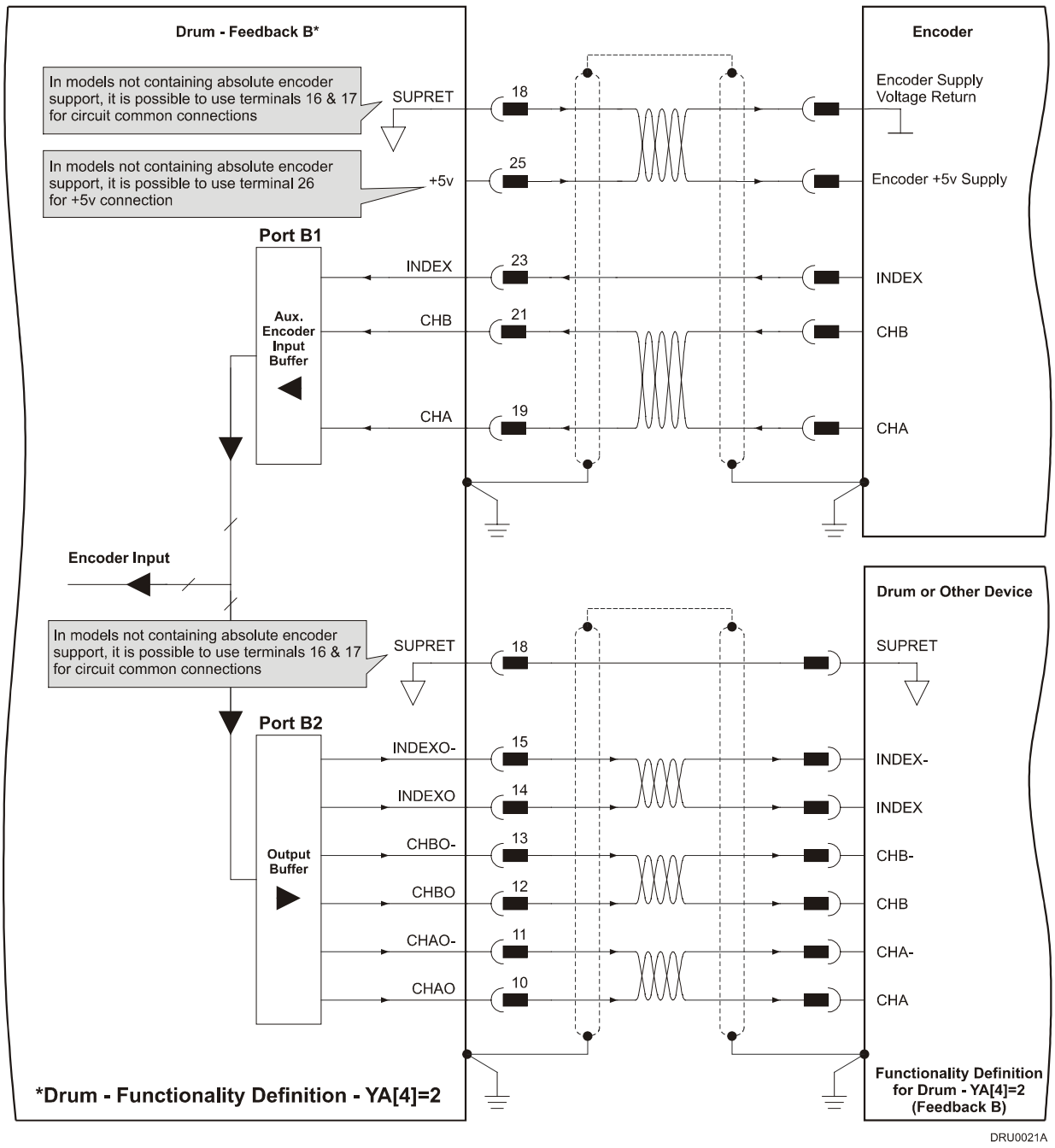
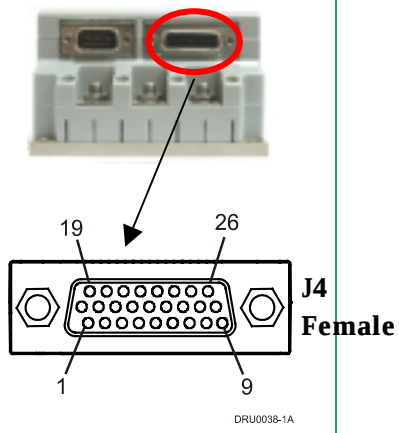
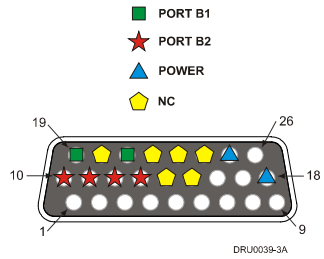


Figure 3-23: ***Single-ended Auxiliary Input Option on FEEDBACK B - Connection Diagram***

3.4.6.4 Pulse-and-Direction Input Option on FEEDBACK B (YA[4]=0)

This mode is used for input of differential or single-ended pulse-and-direction position commands on Port B1. In this mode Port B2 provides **differential buffered pulse-and-direction outputs** for another axis.

Below are the signals on the Auxiliary Feedback ports when set up to run as a single-ended pulse-and-direction input:

Port	Pin	Signal	Function	Pin Position
B2	10	CHAO	Channel A output	 **J4 Female** 26 Pin D-Sub High Density Plug
B2	11	CHAO-	Channel A complement output	
B2	12	CHBO	Channel B output.	
B2	13	CHBO-	Channel B complement output	
	14	NC	Do not connect this pin	
	15	NC	Do not connect this pin	
PWR	18	SUPRET	Encoder supply voltage return/ COMRET	
B1	19	PULS/CHA	Pulse/Auxiliary channel A high *input*	
	20	NC	Do not connect this pin	 26 Pin D-Sub Socket
B1	21	DIR/CHB	Direction/Auxiliary channel B high *input*	
	22	NC	Do not connect this pin	
	23	NC	Do not connect this pin	
	24	NC	Do not connect this pin	
PWR	25	+5V	Encoder supply voltage	

Note: In models not containing absolute encoder support, it is possible to use terminals 16 and 17 for SUPRET connections.

Table 3-11: ***Single Ended Pulse-and-Direction Auxiliary Encoder Pin Assignment on FEEDBACK B***

FEEDBACK B on the "top" of the Drum has a 26-pin high density D-sub socket. Connect the Auxiliary Feedback cable from the Pulse and Direction Controller to FEEDBACK B using a 26-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

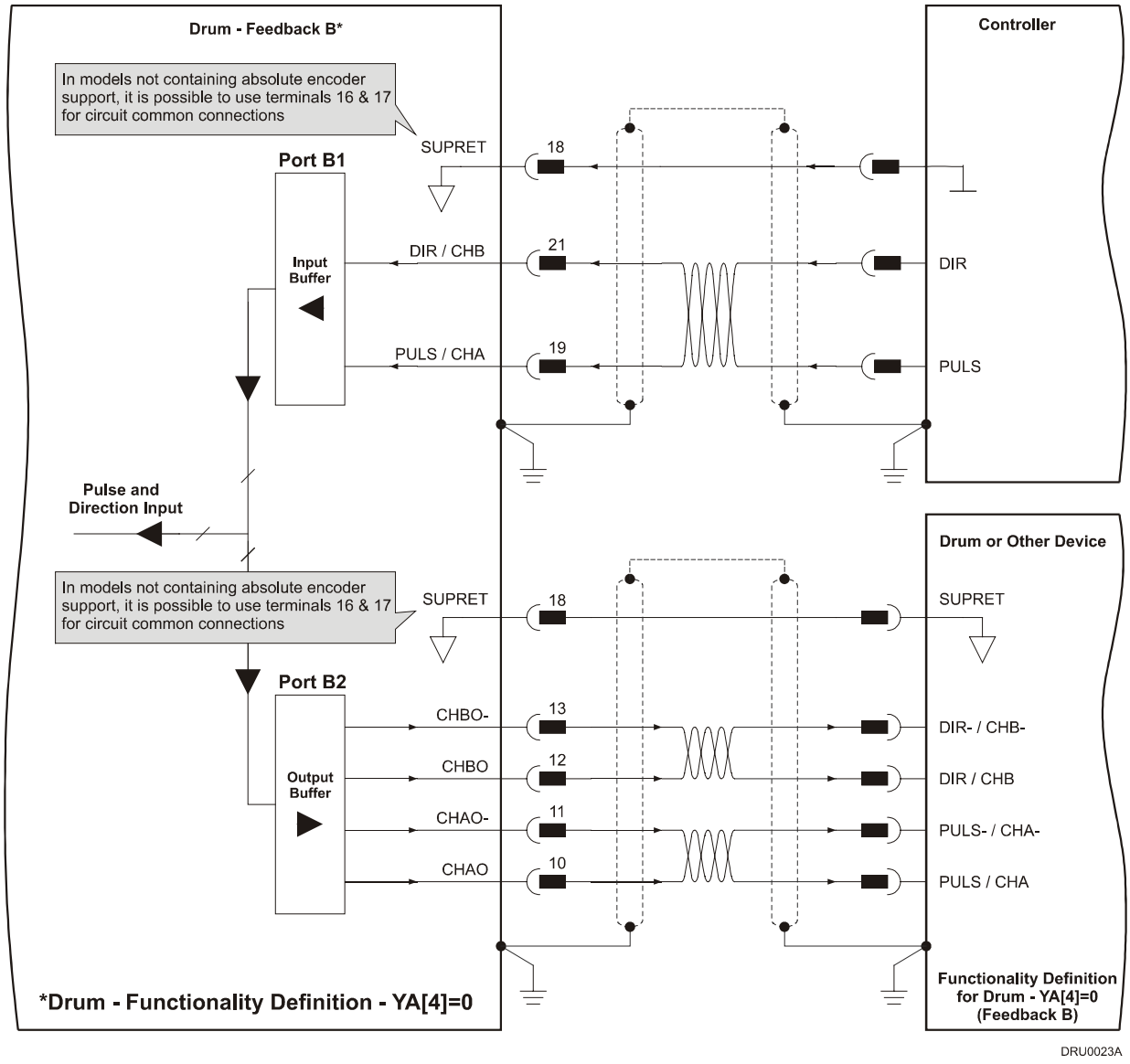
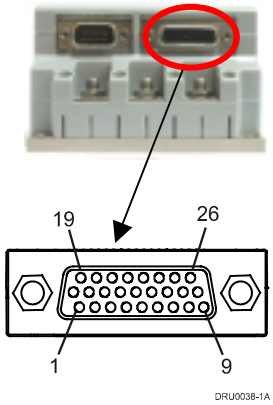
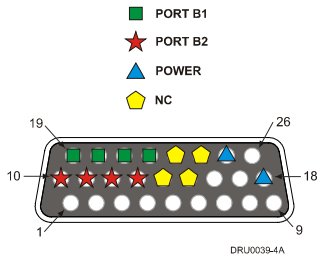


Figure 3-24: ***Single-Ended Pulse-and-Direction Input Option on FEEDBACK B - Connection Diagram***

Below are the signals on the Auxiliary Feedback ports when set up to run as a differential pulse-and-direction input:

Port	Pin	Signal	Function	Pin Position
B2	10	CHAO	Channel A output	 **J4 Female** 26 Pin D-Sub High Density Plug
B2	11	CHAO-	Channel A complement output	
B2	12	CHBO	Channel B output.	
B2	13	CHBO-	Channel B complement output	
	14	NC	Do not connect this pin	
	15	NC	Do not connect this pin	
PWR	18	SUPRET	Encoder supply voltage return/ COMRET	
B1	19	PULS/CHA	Pulse/Auxiliary channel A high *input*	
B1	20	PULS-/CHA-	Pulse/Auxiliary channel A complement high *input*	 26 Pin D-Sub Socket
B1	21	DIR/CHB	Direction/Auxiliary channel B high *input*	
B1	22	DIR-/CHB-	Direction/Auxiliary channel B complement high *input*	
	23	NC	Do not connect this pin	
	24	NC	Do not connect this pin	
PWR	25	+5V	Encoder supply voltage	

Note: In models not containing absolute encoder support, it is possible to use terminals 16 and 17 for SUPRET connections.

Table 3-12: ***Differential Pulse-and-Direction Auxiliary Encoder Pin Assignment on FEEDBACK B***

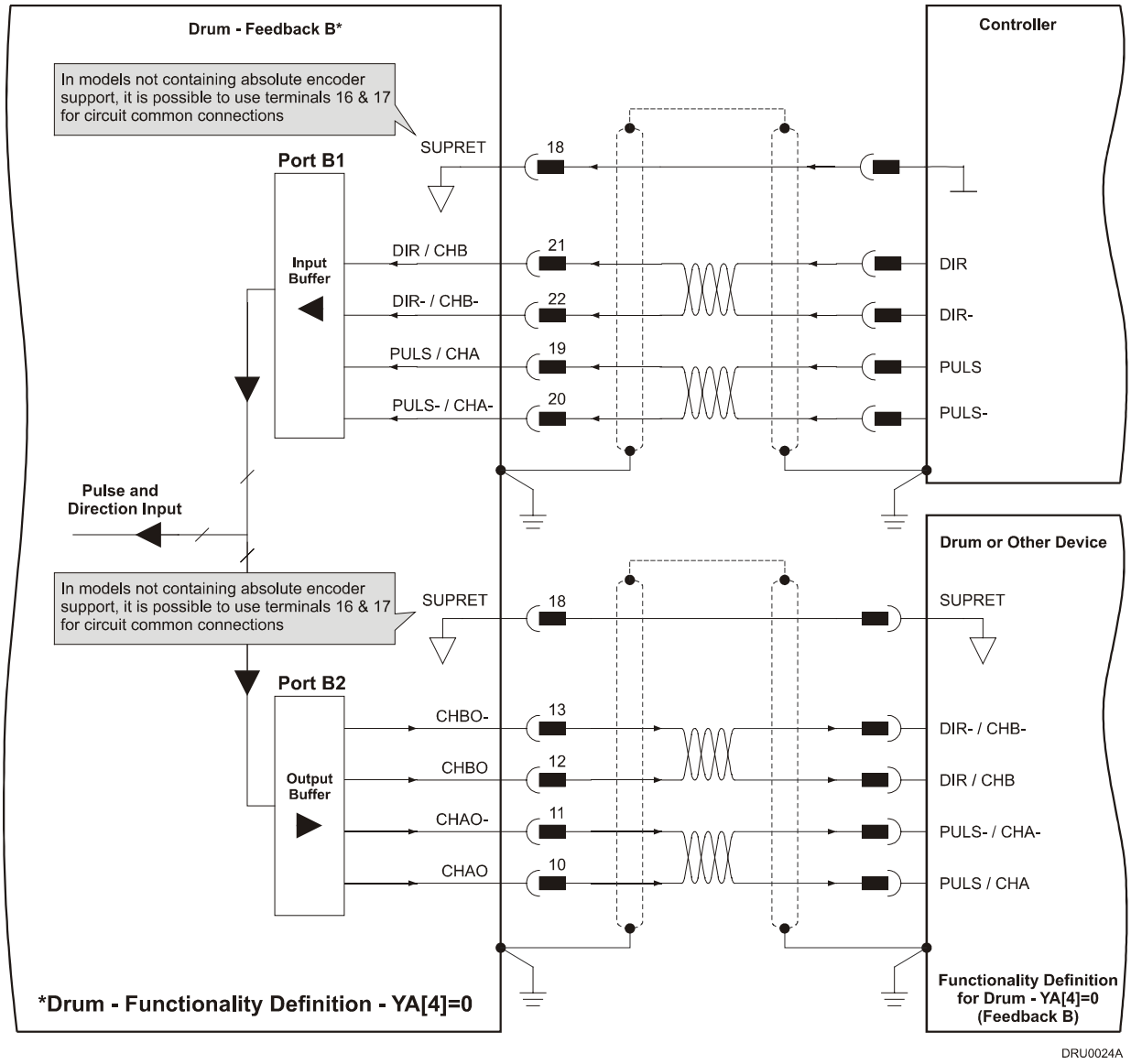


Figure 3-25: ***Differential Pulse-and-Direction Input Option on FEEDBACK B - Connection Diagram***

3.4.7 I/O Cables

The Drum has one I/O port, J3. J3 is a general I/O which can be used to connect 6 digital inputs, 2 digital outputs and 1 analog input.

I/O	J3 Port
Digital Input	6
Digital Output	2
Analog Input	1

3.4.7.1 General I/O Port (J3)

Port J3 has a 15-pin high density D-Sub plug. When assembling this I/O cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies) using a 15-pin high density metal case D-sub female connector (socket).

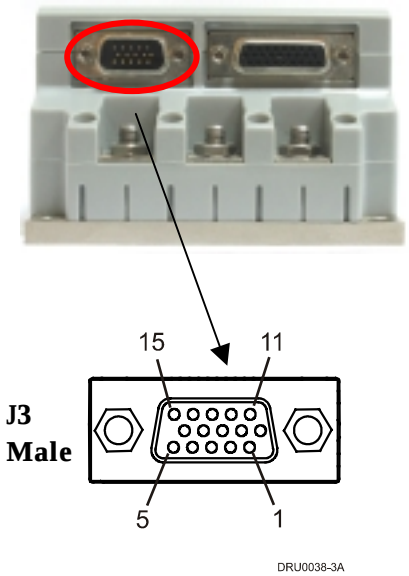
Pin	Signal	Function	Pin Position
1	ANLIN+	Analog input +	
2	ANLIN-	Analog input -	
3	ANLRET	Analog return	
4	OUTRET2	Programmable output return 2	
5	OUT2	Programmable output 2	
6	IN6	Programmable input 6	
7	INRET	General input return	
8	INRET	General input return	
9	OUTRET 1	Programmable output return 1	
10	OUT1	Programmable output 1	
11	IN1	Programmable input 1	
12	IN2	Programmable input 2	
13	IN3	Programmable input 3	
14	IN4	Programmable input 4	
15	IN5	Programmable input 5	

Table 3-13: ***J3 I/O Cable - Pin Assignments***

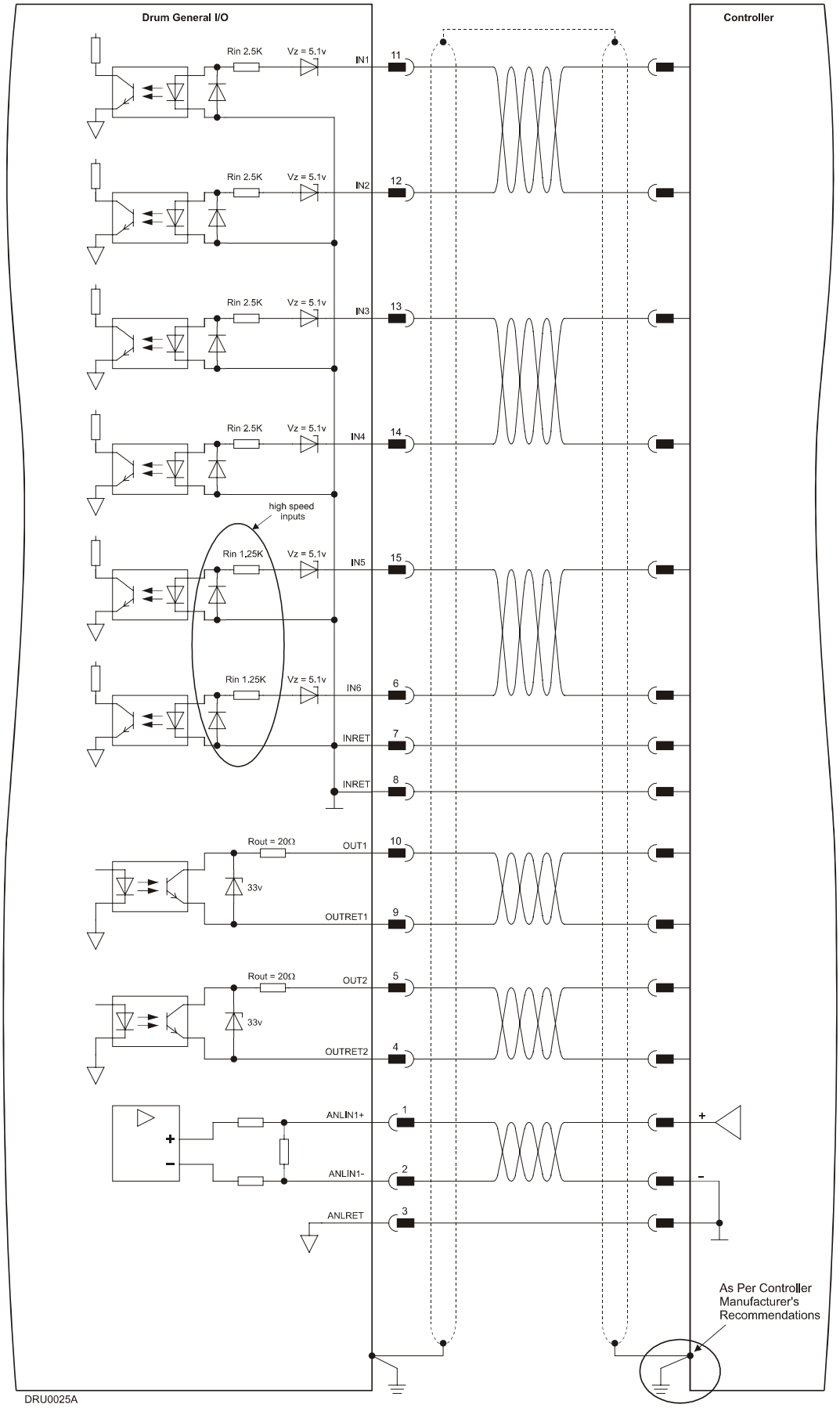


Figure 3-26: ***General J1 I/O Connection Diagram***

3.4.8 Communication Cables

The communication cables use a 9-pin D-sub plug that connect to the RS-232 and 9-pin D-sub socket that connects to the CANopen ports on the Drum.

The communication interface may differ according to the user's hardware. The Drum can communicate using the following options:

a. RS-232, full duplex
b. CANopen

RS-232 communication requires a standard, commercial 3-core null-modem cable connected from the Drum to a serial interface on the PC. The interface is selected and set up in the Composer software.

In order to benefit from **CANopen** communication, the user must have an understanding of the basic programming and timing issues of a CANopen network. The interface is electrically isolated by optocouplers.

For ease of setup and diagnostics of CAN communication, RS-232 and CANopen can be used simultaneously.

3.4.8.1 RS-232 Communication

Notes for connecting the RS-232 communication cable:

- Use a 24, 26 or 28 AWG twisted pair shielded cable (24 AWG cable is recommended). The shield should have aluminum foil covered by copper braid with a drain wire.
- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- Use only a D-sub connector with a **metal housing**.
- Attach the braided shield tightly to the metal housing of the D-type connector.
- When assembling the Communication cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

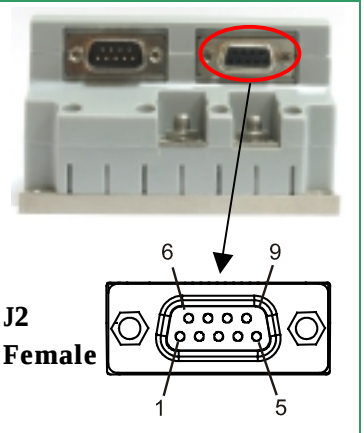
Pin	Signal	Function	Pin Location
1	–	–	
2	Tx	RS-232 transmit	
3	Rx	RS-232 receive	
4	–	–	
5	COMRET	Communication return	
6	–	–	
7	–	–	
8	–	–	

Table 3-14: ***RS-232 Cable - Pin Assignments***

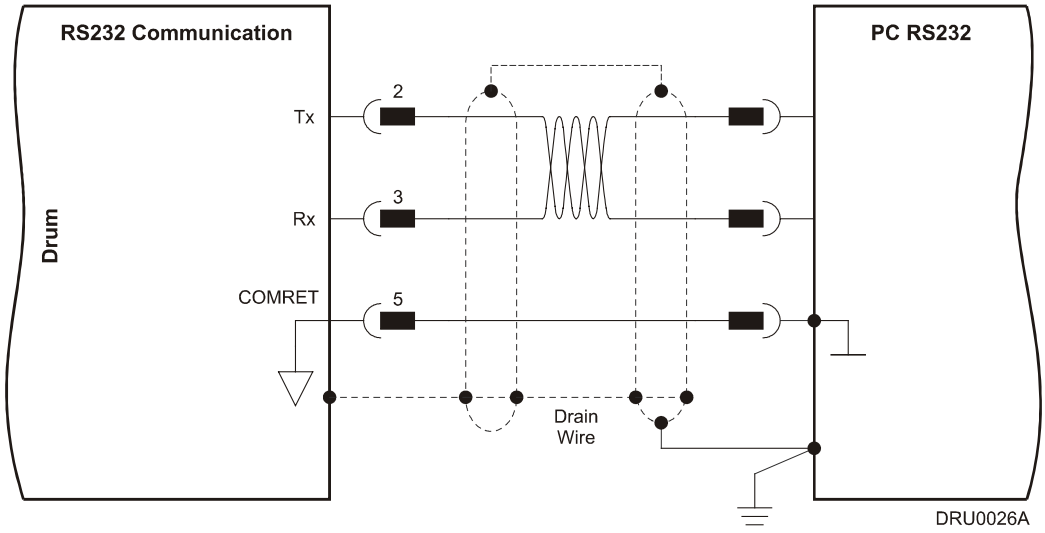


Figure 3-27: ***RS-232 Connection Diagram***

3.4.8.2 CANopen Communication

Notes for connecting the CANopen communication cable:

- Use 24, 26 or 28 AWG twisted pair shielded cables (24 AWG cable is recommended). For best results, the shield should have aluminum foil and covered by copper braid with a drain wire
- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- Use only a D-sub connector with a **metal housing**.
- Attach the braid shield tightly to the metal housing of the D-type connector.
- Connect a termination 120-ohm resistor at each of the two ends of the network cable.
- When assembling the Communication cable, follow the instructions in Section 3.4.3 (Feedback Control and Communication Cable Assemblies).

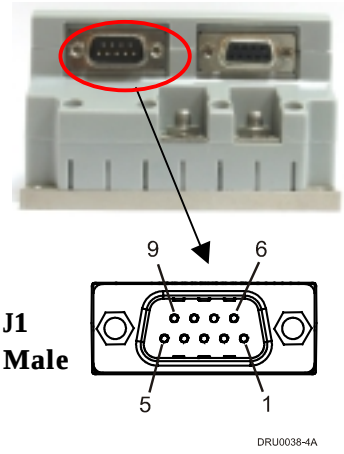
Pin	Signal	Function	Pin Position
1	–	–	
2	CAN_L	CAN_L busline (dominant low)	
3	CAN_GND	CAN ground	
4	–	–	
5	CAN_SHLD	Shield, attach to the metal housing of the D-type	
6	CAN_GND	CAN Ground	
7	CAN_H	CAN_H busline (dominant high)	
8	–	Do not connect	
9	–	Do not connect	

Table 3-15: ***CANopen Cable - Pin Assignments***

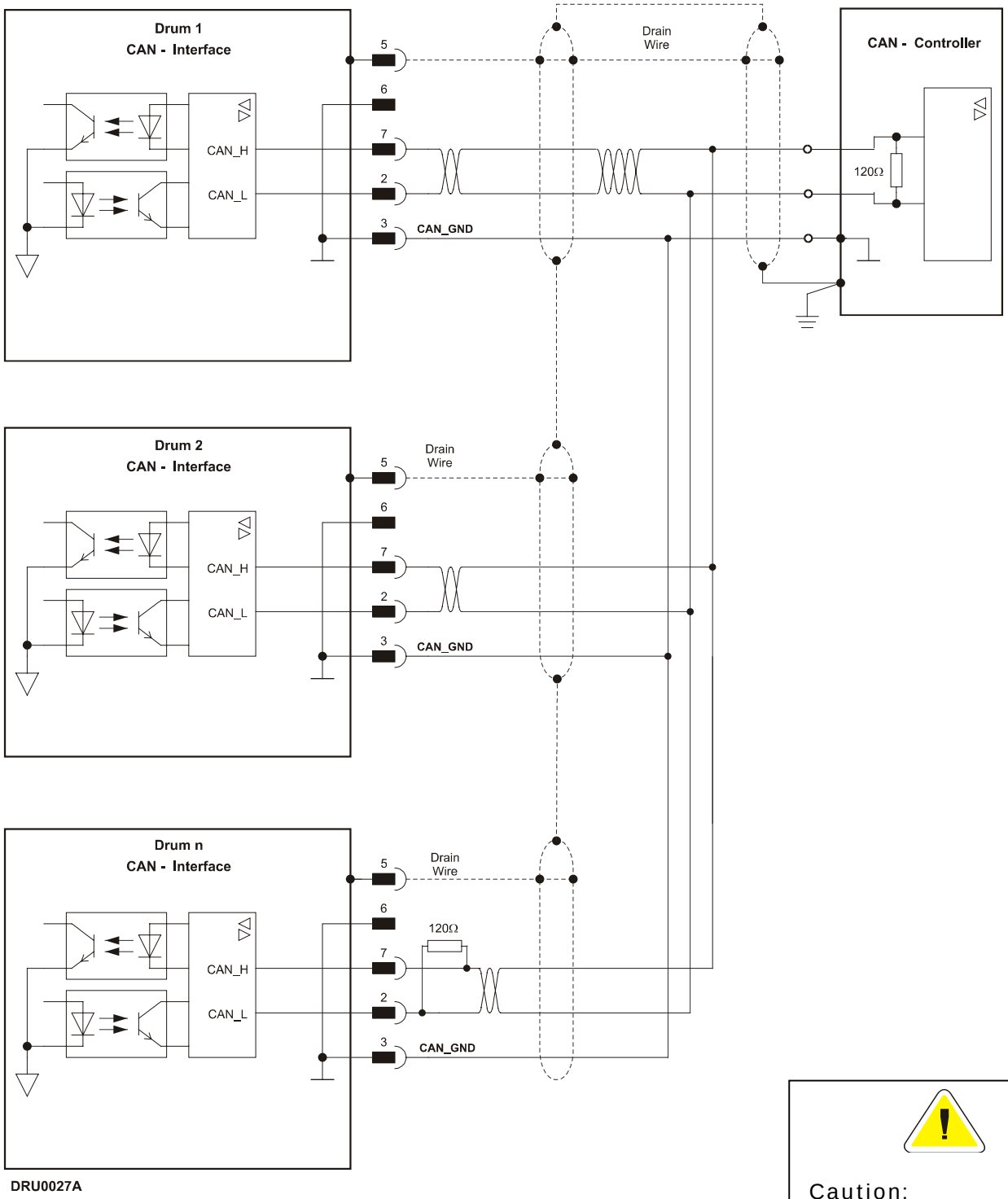


Figure 3-28: ***CANopen Connection Diagram***

Caution:

When installing CANopen communications, ensure that each servo drive is allocated a unique ID. Otherwise, the CANopen network may hang.

3.5 DC Power Supply

The DC power supply can be at any voltage in the range defined in the technical specifications (the Appendix of this guide). The supply source must comply with the safety aspects of the relevant requirements, in accordance with the most recent version of the standard EN60950 or equivalent Low Voltage Directive Standard, all according to the applicable over-voltage category. If the power source to the power supply is the AC line (through an isolated or a non-isolated transformer), safety margins must be considered, in order to avoid activating the under/over voltage protection due to line variations and/or voltage drop under load.

In addition to the above, the transformer must comply with the safety aspects of the relevant requirements in accordance with the most recent version of the standard EN60742 (Isolating and Safety Isolating Transformers). The nominal DC bus voltage should be in the following range:

$$1.2\ V_{dcmin} < V_{dc} < 0.9\ V_{dcmax}$$

Where:
V_{dcmin} is the minimum DC bus
V_{dcmax} is the maximum DC bus

The transformer power should be calculated such that it will be able to deliver power to the amplifier (including peak power) without significant voltage drops.

The power supply should be located as close as possible to the amplifier. While driving high-inertia loads, the power supply must be equipped with a shunt regulator; otherwise, the amplifier will be disabled whenever the capacitors are charged above the maximum voltage, during motor break down.

3.5.1 Powering Up

After the Drum has been mounted, check that the cables are intact. The Drum servo drive is then ready to be powered up.

Caution:
Before applying power, ensure that the DC supply is within the range specified for your specific type of Drum and that the proper plus-minus connections are in order.

3.5.2 Initializing the System

After the Drum has been connected and mounted, the system must be set up and initialized. This is accomplished using the *Composer*, Elmo's Windows-based software application. Install the application and then perform setup and initialization according to the directions in the *Composer Software Manual*.

3.6 Heat Dissipation

For full power output capability the Drum is designed to be mounted on an external heatsink. It is highly recommended that the "Wall" on which the Drum is mounted will have heat dissipation capabilities. The Drum at "free air convection" (without an additional heatsink) can dissipate around 12 W for 40 °C ambient temperature and not exceeding 80 °C on the heatsink.

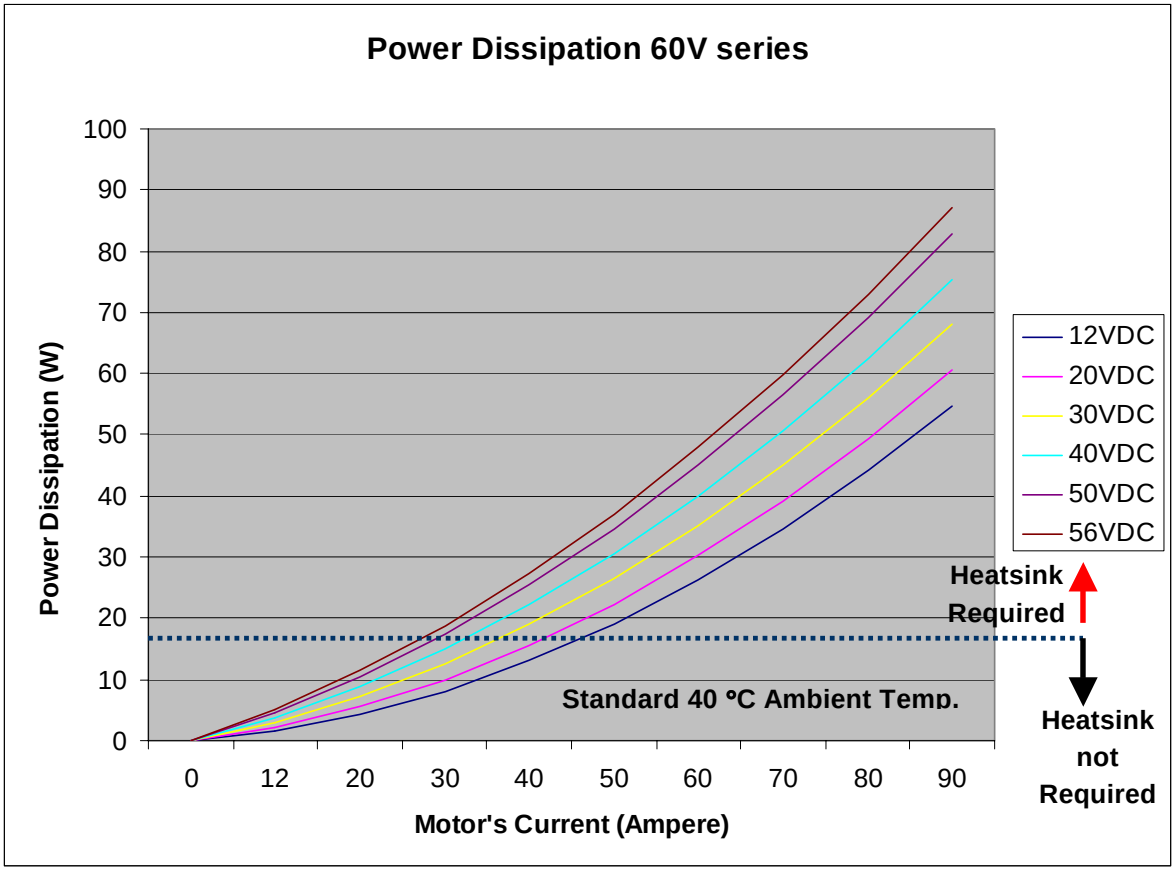
When "Free Air Convection" is sufficient for the application it is recommended to leave approximately 10 mm of space between the Drum's heatsink and any other assembly.

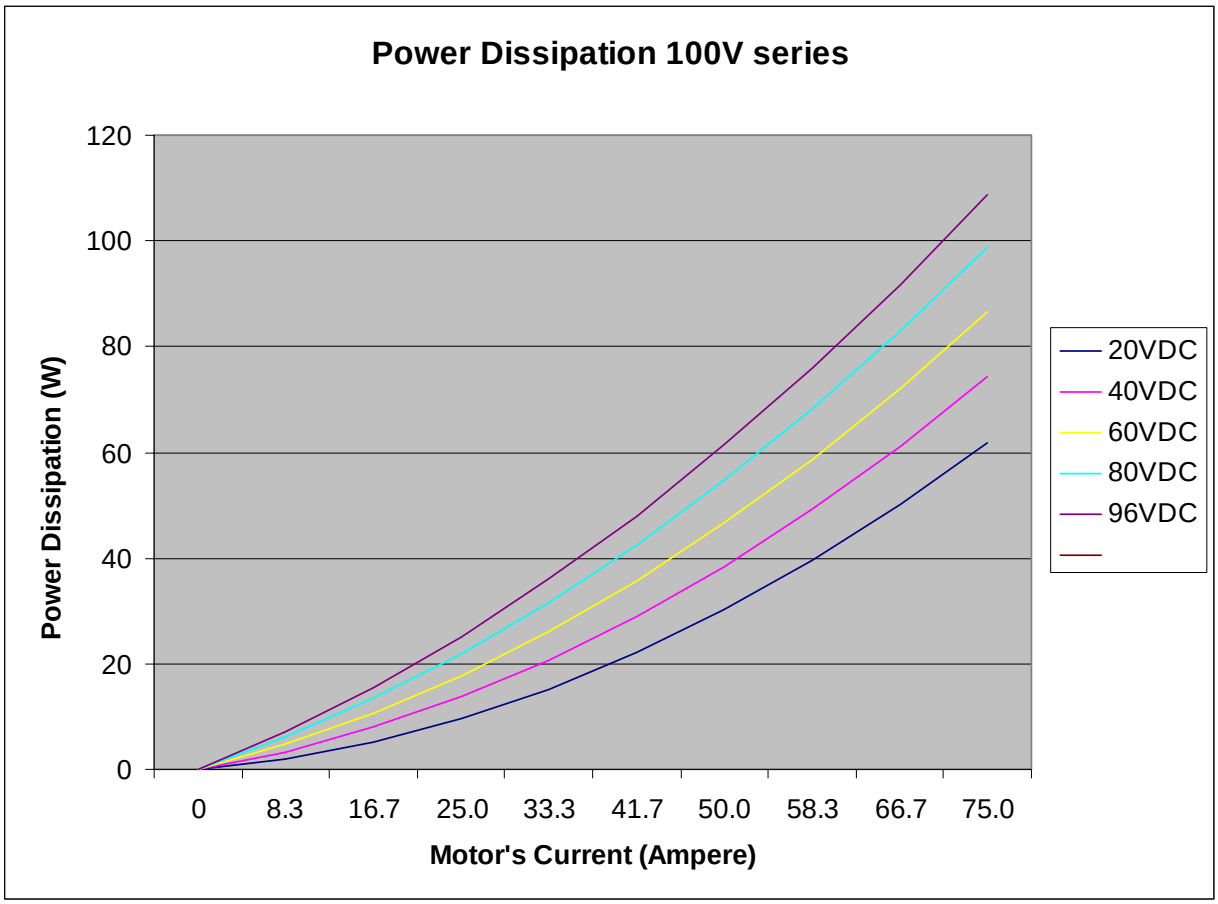
3.6.1 Drum Thermal Data

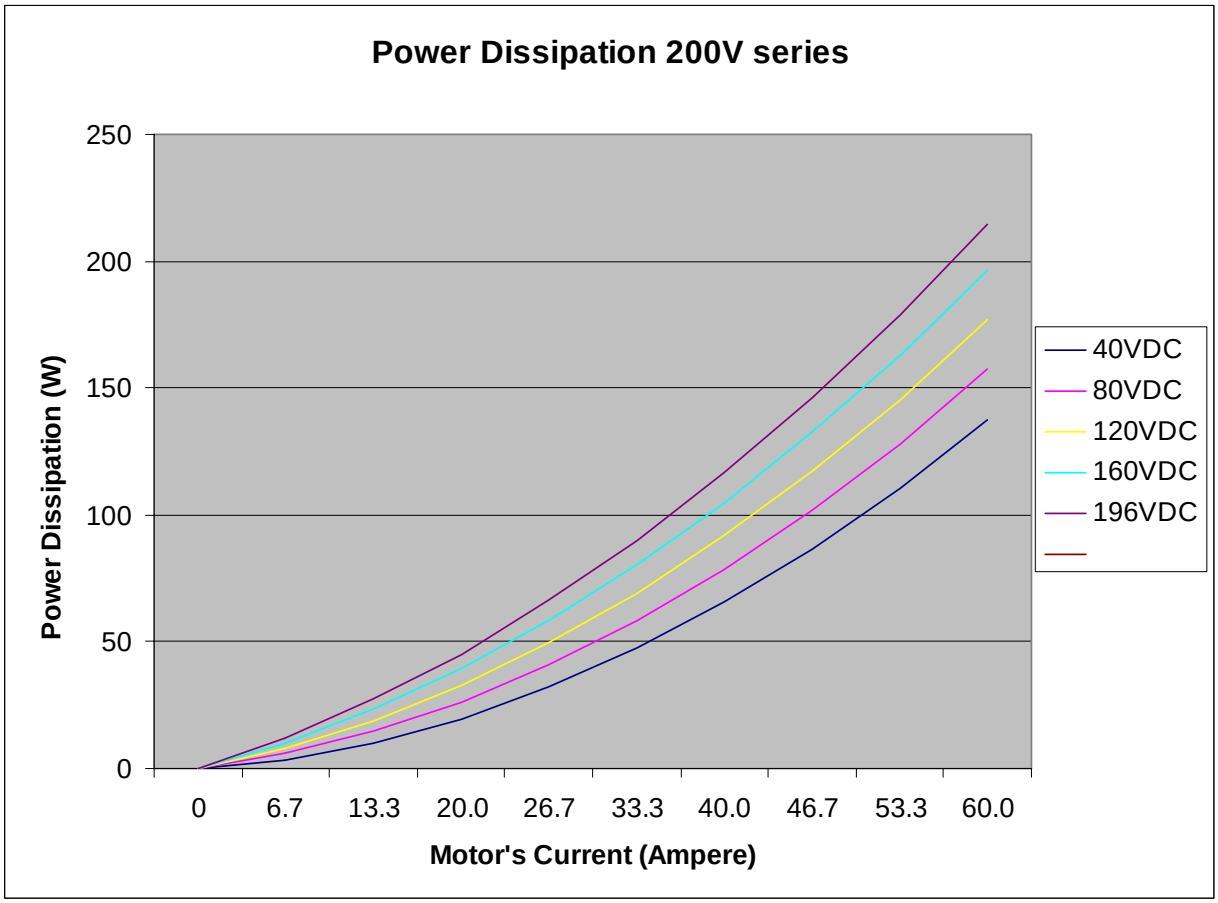
- Free air convection thermal resistance (θ): Approximately 3.6 – 4 °C/W.
- Thermal time constant: Approximately 40 minutes/ 2400 seconds (thermal time constant means that the Drum will reach 2/3 of its final temperature after 4 minutes).
- Self heat dissipation capability (no external heatsink): 12W for 40 °C/W temperature rise.
- Shut-off temperature: 86 °C – 88 °C (measured on the heatsink).
- The thermal resistance when connecting to an external heat sink:
  - The surface of the external heatsink is 50um: 0.18 °C/W.
  - Thermal conductive compound. By proper Smearing of the surface a significant improvement of the thermal resistance is achieved: 0.13 °C/W

3.6.2 Heat Dissipation Data

Heat Dissipation is shown in graphically below:




Power Dissipation 100V series
Power Dissipation (W)
120
100
80
60
40
20
0
0
8.3
16.7
25.0
33.3
41.7
50.0
58.3
66.7
75.0
Motor's Current (Ampere)
20VDC
40VDC
60VDC
80VDC
96VDC


Power Dissipation 200V series
Power Dissipation (W)
250
200
150
100
50
0
0
6.7
13.3
20.0
26.7
33.3
40.0
46.7
53.3
60.0
Motor's Current (Ampere)
40VDC
80VDC
120VDC
160VDC
196VDC

3.6.3 How to Use the Charts

The charts above are based upon theoretical worst-case conditions. Actual test results show 30% - 50% better power dissipation.

To determine if your application needs a heatsink:

1. Allow maximum heatsink temperature to be 80°C or less (shunt down is 6 °C – 8 °C higher).
2. Determine the ambient operating temperature of the Drum as ≤ 40 °C.
3. Calculate the allowable temperature increase as follows:
   - for an ambient temperature of 40°C , ΔT= 80 °C – 40 °C = 40 °C
4. Use the chart to find the actual dissipation power of the drive. Follow the voltage curve to the desired output current and then find the dissipated power.
5. If the dissipated power is below 12 W the Drum needs no additional cooling.

Note: The chart above shows that no heatsink is needed when the heatsink temperature is 80 °C, ambient temperature is 40 °C and heat dissipated is 4 W.

Appendix: Drum Technical Specifications

A.1 Features

A.1.1 Motion Control Modes

- Current/Torque - up to 14 kHz sampling rate
- Velocity - up to 7 kHz sampling rate
- Position - up to 3.5 kHz sampling rate

A.1.2 Advanced Positioning Control Modes

- PTP, PT, PVT, ECAM, Follower, Dual Loop
- Fast event capturing inputs
- Fast output compare (OC)
- Motion Commands: Analog, PWM, digital (SW) and Pulse and Direction

A.1.3 Advanced Filters and Gain Scheduling

- "On-the-Fly" gain scheduling of current and velocity
- Velocity and position with "1-2-4" PIP controllers
- Automatic commutation alignment
- Automatic motor phase sequencing

A.1.4 Fully Programmable

- Third generation programming structure with motion commands – "Metronome"
- Event capturing interrupts
- Event triggered programming
- 32 KB memory

A.1.5 Feedback Options

- Incremental Encoder – up to 20 Mega-Counts (5 Mega-Pulse) per second
- Digital Halls – up to 2 kHz
- Tachometer and potentiometer (optional)
- Incremental Encoder with Digital Halls for commutation – up to 20 Mega-Counts per second for encoder
- Interpolated Analog Encoder (optional)
  - Sine/Cosine Encoder– up to 250 kHz
  - Internal Interpolation - up to x4096
  - Automatic correction of amplitude mismatch, phase mismatch, signal offset
  - Differential encoder buffered outputs
- Resolver (optional)
  - Programmable 10~15 bit resolution
  - Up to 512 revolution per seconds (RPS)
  - Encoder outputs
  - A, B, Index
  - Differential encoder buffered outputs
  - Quadrate

- Absolute Encoder - Heidenhain 2.1 and Stegmann
  - Sine/Cosine Encoder– up to 250 kHz
  - Internal Interpolation - up to x4096
  - Automatic correction of amplitude mismatch, phase mismatch, signal offset
  - Differential encoder buffered outputs
- Auxiliary Encoder inputs (ECAM, follower, etc.)
  - A, B, Index
  - Differential encoder buffered outputs
  - Quadrate

A.1.6 Input/Output

- **Analog Input**– up to 14-bit resolution
- Six programmable **Digital Inputs**, optically isolated, PLC level
  - Inhibit/Enable motion
  - Software and analog reference stop
  - Motion limit switches
  - Begin on input
  - Abort motion
  - Homing
  - General-purpose
- Fast event capture inputs, optically isolated
- Two programmable **Digital Outputs**, optically isolated (open, emitter and collector)
  - Brake Control
  - Amplifier fault indication
  - General-purpose
  - Servo enable indication
- Differential emulated outputs of the resolver, interpolated analog encoder, tachometer and absolute encoder
- Fast output compare (OC), optically isolated
- Pulse and Direction inputs (single-ended and differential)
- PWM current command output

A.1.7 Built-In Protection

- Software error handling
- Abort (hard stops and soft stops)
- Status reporting
- Protection against:
  - Shorts between motor power outputs
  - Shorts between motor power outputs and power input/return
  - Failure of internal power supplies
  - Over temperature
    - Cont. temperature measurement. Temperature can be read on the fly, Warning can be initiated X degrees before temp disable is activated.
  - Over/Under voltage
  - Loss of feedback

- Following error
- Current limits
- Loss of commutation signals
- Communication error

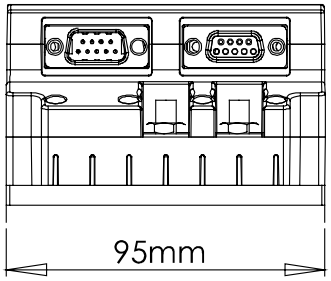
A.1.8 Accessories

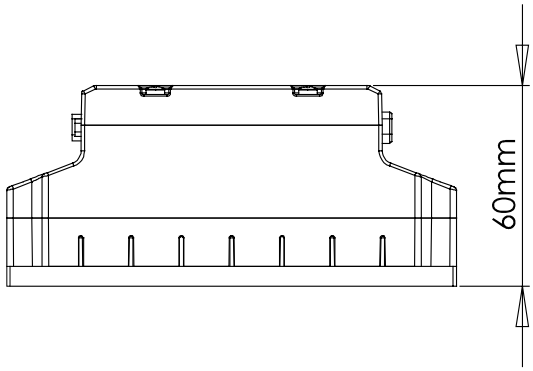
- Cable Kit

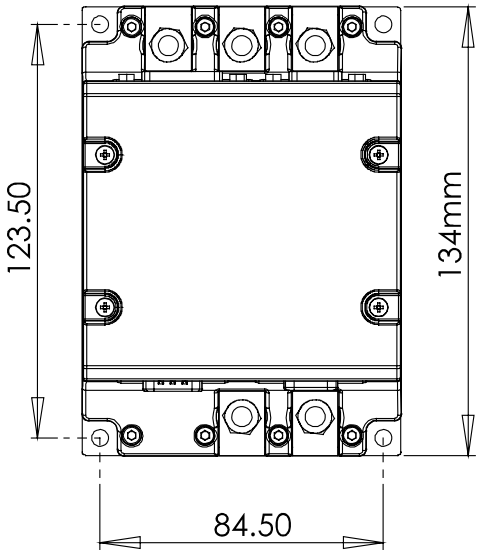
A.1.9 Automatic Procedures

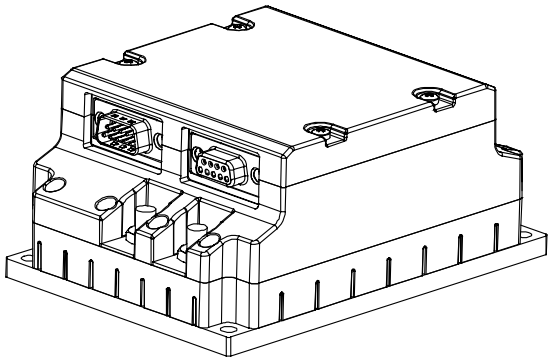
- Commutation alignment
- Phase sequencing
- Current loop offset adjustment
- Current loop gain tuning
- Current gain scheduling
- Velocity loop offset adjustment
- Velocity gain tuning
- Velocity gain scheduling
- Position gain tuning

A.2 Dimensions









DRU0003A

A.3 Power Ratings

Feature	**Units**	**70/48**	**70/60**	**R90/60**	**50/100**	**R75/100**	**35/200**	**R60/200**	**18/400**
Minimum supply voltage	VDC	11	14		23		46		92
Nominal supply voltage	VDC	42	50		85		170		340
Maximum supply voltage	VDC	48	59		95		195		390
Maximum continuous power output	W	2700	3400	4300	4000	6000	5600	9600	5600
Efficiency at rated power (at nominal conditions)	%	> 97							
Maximum output voltage		97% of DC bus voltage at f=22 kHz							
Amplitude sinusoidal/DC continuous current	A	70	70	90	50	75	35	60	18
Sinusoidal continuous RMS current limit (Ic)	A	50	50	63	35	53	25	42	12.7
Peak current limit	A	2 x Ic	2 x Ic	No Peak	2 x Ic	No Peak	2 x Ic	No Peak	2 x Ic
Weight	g (oz)	700 g (24.7 oz)							
Dimensions	mm (in)	134 x 95 x 60 (5.3" x 3.7" x 2.4")							
Digital in/Digital out/Analog in		6/2/1							
Mounting method		Panel mount							

A.4 Environmental Conditions

Feature	**Details**
Ambient operating temperature	0 °C – 40 °C (32 °F – 104°F)
Storage temperature	-20 °C – 85 °C (-4 °F – +185 °F)
Maximum humidity	90% non-condensing
Protection level	

A.4.1 Auxiliary Supply

Feature	Details
Auxiliary power supply	*Isolated DC source only*
Auxiliary supply input voltage	12 VDC ~ 195 VDC
Auxiliary supply input power	< 4 VA (this includes the 5V/200 mA load for the main encoder only) < 5.5 VA (this includes the 5V/400 mA load on the main encoder and feedback B)

A.5 Control Specifications

A.5.1 Current Loop

Feature	Details
Controller type	Vector, digital
Compensation for bus voltage variations	"On-the-fly" automatic gain scheduling
Motor types	▪ AC brushless (sinusoidal) ▪ DC brushless (trapezoidal) ▪ DC brush ▪ Linear motors ▪ Moving coils
Current control	▪ Fully digital ▪ Sinusoidal with vector control ▪ Programmable PI control filter based on a pair of PI controls of AC current signals and constant power at high speed
Current loop bandwidth	< 2.5 kHz
Current loop sampling time	Programmable 70 - 100 µsec
Current loop sampling rate	Up to 16 kHz; default 11 kHz

A.5.2 Velocity Loop

Feature	Details
Controller type	PI
Velocity control	▪ Fully digital ▪ Programmable PI and FFW control filters ▪ "On-the-fly" gain scheduling ▪ Automatic, manual and advanced manual tuning
Velocity and position feedback options	▪ Incremental Encoder ▪ Absolute Encoder- Heidenhain and Stegmann ▪ Digital Halls ▪ Interpolated Analog (sin/cos) Encoder (optional) ▪ Resolver (optional) ▪ Tachometer and Potentiometer (optional)
Velocity loop bandwidth	< 350 Hz
Velocity loop sampling time	140 - 200 µsec (x2 current loop sample time)
Velocity loop sampling rate	up to 8 kHz; default 5.5 kHz
Velocity command options	▪ Analog ▪ Internally calculated by either jogging or step **Note:** All software-calculated profiles support on-the-fly changes.

A.5.3 Position Loop

Feature	Details
Controller type	"1-2-4" PIP
Position command options	▪ Software ▪ Pulse and Direction ▪ Analog Potentiometer
Position loop bandwidth	< 80 Hz
Position loop sampling time	280 - 400 µsec (x 4 current loop sample time)
Position loop sampling rate	up to 4 kHz; default 2.75 kHz

A.6 Feedbacks

A.6.1 Feedback Supply Voltage

The Drum has two feedback ports (main and auxiliary). The drives supply voltage to the main and auxiliary feedback devices (200 mA to the main feedback and 200 mA to the auxiliary feedback).

Feature	Details
Main encoder supply voltage	5 V ±5% @ 200 mA
Auxiliary encoder supply voltage	5 V ±5% @ 200 mA

A.6.2 Main Feedback Options

A.6.2.1 Incremental Encoder Input

Feature	Details
Encoder format	▪ A, B and Index ▪ Differential ▪ Quadrature
Interface	RS-422
Input resistance	Differential: 120 Ω
Maximum incremental encoder frequency	Maximum absolute: 5 MHz pulses
Minimum quadrature input period (P_{IN})	112 nsec
Minimum quadrature input high/low period (P_{HL})	56 nsec
Minimum quadrature phase period (P_{PH})	28 nsec
Maximum encoder input voltage range	Common mode: ±7 V Differential mode: ±7 V

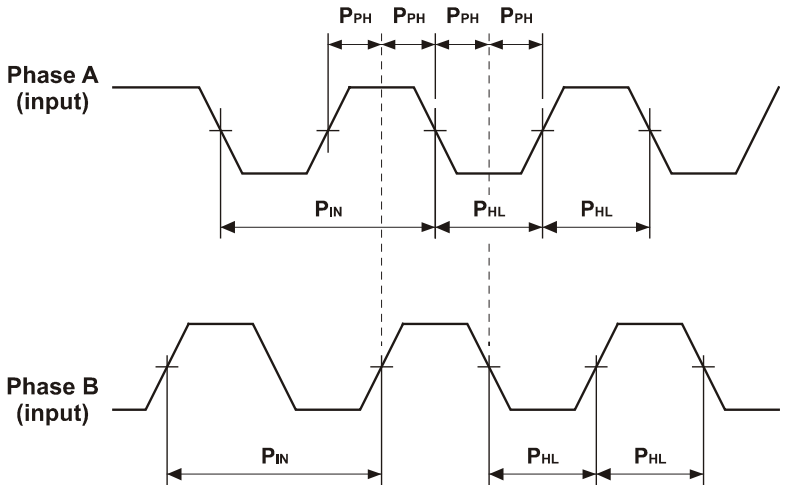


Figure A-1: ***Main Feedback - Encoder Phase Diagram***

A.6.2.2 Digital Halls

Feature	Details
Halls inputs	▪ H_A, H_B, H_C. ▪ Single ended inputs ▪ Built in hysteresis of 1 V for noise immunity
Input voltage	Nominal operating range: 0 V < V_{In_Hall} < 5 V Maximum absolute: -1 V < V_{In_Hall} < 15 V High level input voltage: V_{InHigh} > 2.5 V Low level input voltage: V_{InLow} < 1 V
Input current	Sink current (when input pulled to the common): 3 mA
Maximum frequency	f_{MAX} : 2 kHz

A.6.2.3 Interpolated Analog Encoder (Sine/Cosine)

Feature	Details
Analog encoder format	Sine and Cosine signals
Analog input signal level	▪ Offset voltage: 2.2 V – 2.8 V ▪ Differential, 1 V peak to peak
Input resistance	Differential 120 Ω
Maximum analog signal frequency	f_{MAX} : 250 kHz
Interpolation multipliers	Programmable: x4 to x4096
Maximum "counts" frequency	80 mega-counts/sec "internally"
Automatic errors correction	Signal amplitudes mismatch Signal phase shift Signal offsets
Encoder outputs	See Auxiliary Encoder Outputs specifications (0)

A.6.2.4 Resolver

Feature	Details
Resolver format	▪ Sine/Cosine ▪ Differential
Input resistance	Differential 2.49 kΩ
Resolution	Programmable: 10 ~ 15 bits
Maximum electrical frequency (RPS)	512 revolutions/sec
Resolver transfer ratio	0.5

Feature	Details
Reference frequency	1/Ts (Ts = sample time in seconds)
Reference voltage	Supplied by the Drum
Reference current	up to ±50 mA
Encoder outputs	See Auxiliary Encoder Output specifications (0)

A.6.2.5 Tachometer*

Feature	Details
Tachometer format	Differential
Maximum operating differential voltage for TAC1+, TAC1-	±20 V
Maximum absolute differential input voltage for TAC1+, TAC1-	±25 V
Maximum operating differential voltage for TAC2+, TAC2-	±50 V
Maximum absolute differential input voltage for TAC2+, TAC2-	±50 V
Input resistance for TAC1+, TAC1-	46 kΩ
Input resistance for TAC2+, TAC2-	100 kΩ
Resolution	14 bit

***** Only one Tachometer port can be used at a time (either TAC1+/TAC1- or TAC2+/TAC2-).
TAC1+/TAC1- is used in applications with having a Tachometer of less than 20V.
TAC2+/TAC2- is used in applications with having a Tachometer of between 20V and 50V.

A.6.2.6 Potentiometer

Feature	Details
Potentiometer Format	Single-ended
Operating Voltage Range	0 ~ 5 V supplied by the Drum
Potentiometer Resistance	100 Ω ~ 1 kΩ … above this range, linearity is affected detrimentally
Input Resistance	100 kΩ
Resolution	14 Bit

A.6.2.7 Absolute Encoder

Feature	Details
Analog encoder format	Sine and Cosine signals
Analog input signal level	▪ Offset voltage: 2.2 V – 2.8 V ▪ Differential, 1 V peak to peak
Input resistance	Differential 120 Ω
Maximum analog signal frequency	f_{MAX} : 250 kHz
Interpolation multipliers	Programmable: x4 to x4096
Maximum "counts" frequency	80 mega-counts/sec "internally"
Automatic errors correction	Signal amplitudes mismatch Signal phase shift Signal offsets
Encoder outputs	See Encoder Outputs specifications (A.6.2.8)

A.6.2.8 Encoder Outputs

Feature	Details
Encoder output format	▪ A, B, Index (not available in analog and absolute encoders) ▪ Differential outputs ▪ Quadrature
Interface	RS-422
Port B1 output current capability	▪ Driving differential loads of 200 Ω on INDEX/INDEX-, CHB/CHB- and CHA/CHA- pairs

Feature	Details
Port B2 output current capability	▪ INDEXO/INDEXO-, CHBO/CHBO- and CHAO/CHAO- pairs are not loaded
Available as options	▪ Two simultaneous buffered outputs of main-incremental encoder input ▪ Two simultaneous emulated encoder outputs of analog or absolute encoder input ▪ Two simultaneous emulated encoder outputs of resolver input ▪ Buffered output of auxiliary input
Maximum frequency	f_{MAX} : 5 MHz pulses/output
Index (marker)	Length of pulse is one quadrature (one quarter of an encoder cycle) and synchronized to A&B

A.6.3 Auxiliary Port

Feature	Details
Encoder input, emulated output, pulse and direction	▪ A, B, Index ▪ Differential or single ended ▪ Quadrature
Output current capability	120 Ω
Available as options	▪ Emulated encoder outputs of analog encoder ▪ Emulated encoder outputs of the resolver ▪ Emulated encoder outputs of the potentiometer ▪ Emulated encoder outputs of the tachometer ▪ Main encoder buffered output ▪ P&D buffered output ▪ Emulated encoder outputs of the absolute encoder
Maximum frequency	f_{MAX} : 5 MHz pulses/output
Edge separation between A & B	Programmable number of clocks to allow adequate noise filtering at remote receiver of emulated encoder signals
Index (marker):	Length of pulse is one quadrature (one quarter of an encoder cycle) and synchronized to A&B

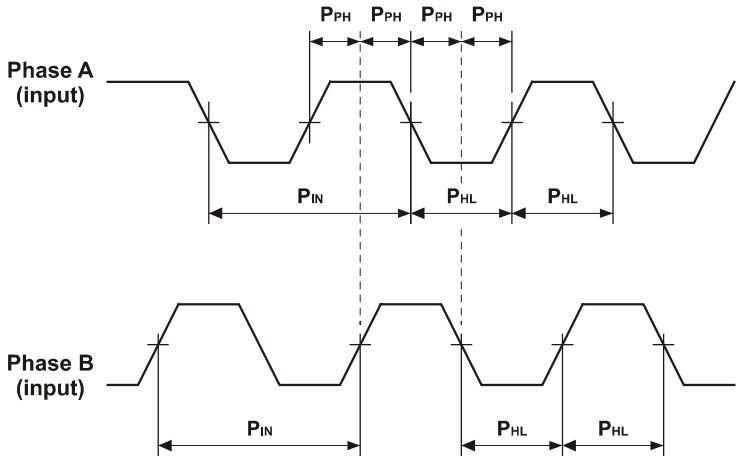
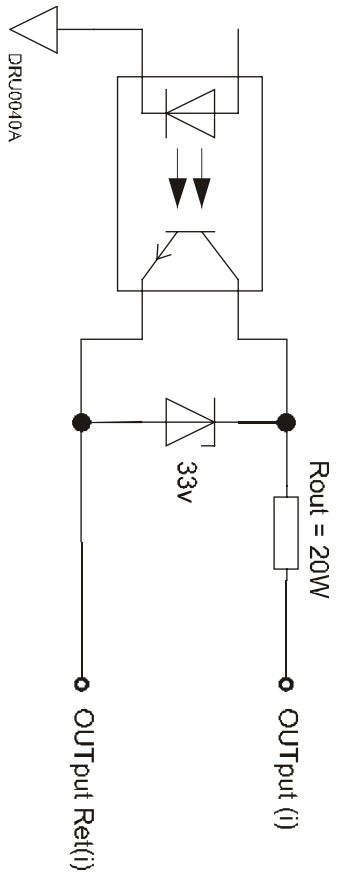


Figure A-2: ***Auxiliary Feedback - Encoder Phase Diagram***

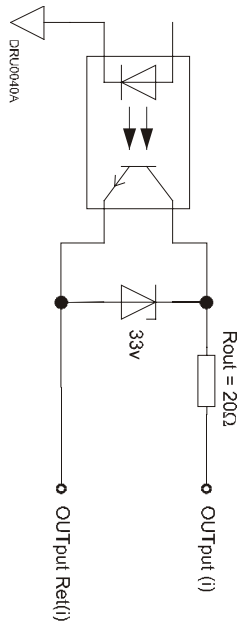
A.7 I/Os

The Drum has: 6 Digital Inputs 2 Digital Outputs 1 Analog Input

A.7.1 Digital Input Interfaces

Feature	Details	Connector Location
Type of input	▪ Optically isolated ▪ Single ended ▪ PLC level	
Input current	$Iin = \frac{Vin - 6.5V}{2500\Omega}$ * Iin = 2.2 mA @ Vin = 12 V	
Input current for high speed inputs	$Iin = \frac{Vin - 6.5V}{1250\Omega}$ * Iin = 4.4 mA @ Vin = 12 V	
High-level input voltage	12 V < Vin < 30 V, 24 V typical	
Low-level input voltage	0 V < Vin < 6.5 V	
Minimum pulse width	> 4 x TS, where TS is sampling time	
Execution time (all inputs): the time from application of voltage on input until execution is complete	If input is set to one of the built-in functions — Home, Inhibit, Hard Stop, Soft Stop, Hard and Soft Stop, Forward Limit, Reverse Limit or Begin — execution is immediate upon detection: 0<T<4xTS If input is set to General input, execution depends on program. Typical execution time: ≅ 0.5 msec.	
High-speed inputs – 5 & 6 minimum pulse width, in high-speed mode	T < 5 µsec **Notes:** ▪ Home mode is high-speed mode and can be used for fast capture and precise homing ▪ High speed input has a digital filter set to same value as digital filter (EF) of main encoder ▪ Highest speed is achieved when turning on optocouplers	 ***Digital Input Schematic***

A.7.2 Digital Output Interface

Feature	Details	Connector Location
Type of output	▪ Optically isolated ▪ Open collector and open emitter	
Maximum supply output (Vcc)	30 V	
Max. output current Iout (max) (Vout = Low)	Iout (max) ≤ 15 mA	
VOL at maximum output voltage (low level)	Vout (on) ≤ 0.3 V + 0.02 * Iout (mA)	
RL	External resistor RL must be selected to limit output current to no more than 15 mA. $R_L = \frac{Vcc - VOL}{Io(\max)}$	
Executable time	If output is set to one of the built-in functions — Home flag, Brake or AOK — execution is immediate upon detection: 0 < T < 4 x TS If output is set to General output and is executed from a program, the typical time is approximately 0.5 msec.	 ***Digital Output Schematic***

A.7.3 Analog Input

Feature	Details
Maximum operating differential voltage	± 10 V
Maximum absolute differential input voltage	± 16 V
Differential input resistance	3.74 kΩ
Analog input command resolution	14-bit

A.8 Communications

Specification	Details
RS-232	**Signals:** ▪ RxD , TxD , Gnd ▪ Full duplex, serial communication for setup and control ▪ Baud Rate of 9,600 ~ 57,600 bit/sec
CANopen	**CANbus Signals:** ▪ CAN_H, CAN_L, CAN_GND ▪ Maximum Baud Rate of 1 Mbit/sec **Version:** ▪ DS 301 V4.01 **Device Profile** (drive and motion control)**:** ▪ DS 402

A.9 Pulse Width Modulation (PWM)

Feature	Details
PWM resolution	12-bit
PWM switching frequency on the load	2/Ts (factory default 22 kHz on the motor)

A.10 Standards Compliance

A.10.1 Quality Assurance

Specification	Description
ISO 9001:2000	Quality Management

A.10.2 Design

Specification	Description
In compliance with **MIL-HDBK-217**	Reliability Prediction of Electronic Equipment (rating,de-rating,stress.etc)
▪ **IPC-D-275** ▪ **IPC-SM-782** ▪ **IPC-CM-770** ▪ **UL508c** ▪ **UL840**	Reliability prediction of electronic equipment (rating, de-rating, stress, etc.) Printed wiring for electronic equipment (clearance, creepage, spacing, conductors sizing, etc.)
In compliance with **VDE0160-7 (IEC68)**	Type testing

A.10.3 Safety

Specification	Description
In compliance with **UL508c**	Power conversion equipment
In compliance with **UL840**	Insulation coordination, including clearance and creepage distances of electrical equipment
In compliance with **UL60950**	Safety of information technology equipment, including electrical business equipment
In compliance with **EN60204-1**	Low voltage directive, 72/23/EEC

A.10.4 EMC

Specification	Description
In compliance with EN55011 Class A with EN61000-6-2: Immunity for industrial environment, according to: IEC61000-4-2 / criteria B IEC61000-4-3 / criteria A IEC61000-4-4 / criteria B IEC61000-4-5 / criteria B IEC61000-4-6 / criteria A IEC61000-4-8 / criteria A IEC61000-4-11 / criteria B/C	Electromagnetic compatibility (EMC)

A.10.5 Workmanship

Specification	Description
In compliance with **IPC-A-610**, level 3	Acceptability of electronic assemblies

A.10.6 PCB

Specification	Description
In compliance with **IPC-A-600**, level 3	Acceptability of printed circuit boards

A.10.7 Packing

Specification	Description
In compliance with **EN100015**	Protection of electrostatic sensitive devices

A.10.8 WEEE*

Specification	Description
In compliance with **2002/96/EC**	Waste Electrical and Electronic Equipment regulations

* Please send out-of-service Elmo drives to the nearest Elmo sales office.

A.10.9 RoHS

Specification	Description
In compliance with **2002/95/EC** (effective July 2006)	Restrictions on Application of Hazardous Substances in Electric and Electronic Equipment